NEW SERIES

SELECTED

ESOURCESABSTRACTS



VOLUME 2, NUMBER 6 MARCH 15, 1969

NEW SERIES

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is \$22.00 (domestic), \$27.50 (foreign); single copy price is \$3.00.



SELECTED

WATER RESOURCES ABSTRACTS

'A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior



VOLUME 2, NUMBER 6 MARCH 15, 1969

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States--now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

02. WATER CYCLE

2A. General

ROLE OF DIGITAL COMPUTERS HYDROLOGIC **FORECASTING** ANALYSES,

For primary bibliographic entry see Field 07C. For abstract, see.

W69-02245

THE ROLE OF PARAMETRIC HYDROLOGY,

University College, Galway, Ireland.

J. E. Nask

Instn Water Eng J, Vol 21, No 5, pp 435-474 July, 1967 25 ref.

*Rainfall-runoff relationships, *Hydrographs, Storm runoff, Model studies. Identifiers: *Calculations.

Parametric hydrology is defined and its advantages, uses and techniques are described. The rational method is briefly described. A method of graphical correlation of observed volumes of storm run-off to the amounts and duration of rainfall and conditions in the basin at the time of the storm is described. The unit hydrograph method of measuring the distribution of run-off in time is presented. Equations and parameters are developed for this method based on basin characteristics and other variables. Conceptual models and hydrologic frequency are discussed. A lengthy discussion follows the paper. W69-02249

REGRESSION MODELS FOR PREDICTING ON-SITE RUN-OFF FROM SHORT DURATION CONVECTIVE STORMS,

H. A. Schreiber, and D. R. Kincaid. Water Resour Res, Vol 3, pp 389-395, 1967.

Identifiers: *Calculations.

Descriptors: *Storm runoff, *Rainfall intensity, *Model studies

Experimental plots were used to study the on-site run-off resulting from 34 summer convective thun-derstorms in the Walnut Gulch experimental watershed, Ariz. It was found that run-off increased with increase in precipitation and decreased as antecedent soil moisture and crown spread of vegetation increased. Six independent variables were used in a step-wise multiple linear regression equation to determine the importance of total quantity per storm in inches; maximal 5-minute intensity in inches per hour; and duration of storm in minutes. W69-02260

WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA,

W. M. Snyder.

Int Geodetic and Geophysical Union-Sec for Sci Hydrology Publ No 63, pp 18-30, 1964.

Descriptors: *Rainfall-runoff relationships, Runoff, Watersheds, Model studies. Identifiers: *Calculations.

Mathematical model has been developed to mathematical model has been developed to analyze past records of streamflow and to predict dependable yield from watersheds under varying patterns of rainfall; model contains three parts; first, seasonal rainfall function generates potential runoff in two phases—immediate and delayed; second, distribution function delivers delayed runoff to future streamflow; bird, time, transfunctions delivers delayed runoff to future streamflow; bird, time, transfunctions noff to future streamflow; third, time-trend function compensates for changing watershed conditions; ten test sets of data were analyzed. W69-02266

SIMPLIFIED VERSUS OPTIMUM HYDROGRAPHS - ONE COMPARISON, W. W. Spyder, Water P. UNIT

Water Resources Res, Vol 3, No 4, pp 947-948,

Descriptors: *Hydrographs, *Rainfall-runoff relationships. Identifiers: *Urban hydrology.

A unit hydrograph is derived from a record storm previously analyzed for the optimum realizable unit hydrograph. The storm data, an urban rainfall-runoff event, and original analysis are given in Eagleson. et al Water Res. Res 2 (4):755. The sim-

plified curve-fitting procedures produce a more rational appearing unit hydrograph in this case study. W69-02267

RAINFALL AND RUN-OFF IN THE DERWENT VALLEY TO DERBYSHIRE, TO YORKSHIRE BRIDGE.

R. W. S. Thompson, and K. J. H. Saxton. Proc Instn Civ Engrs, Vol 25, Paper No 6664, pp 147-164, 1963.

Descriptors: *Rainfall-runoff relationships.

Tabulated hydrometric data over the past 60 years are given for the catchment area of the Derwent Valley Water Board on the river Derwent in north Derbyshire. The relations between rainfall and runoff in the area are discussed. W69-02272

HYDROLOGICAL OBSERVATIONS.

S. J. van Kregten.

Verslagen en Mededelingen, No 9-Verslag van de Technische Bijeenkomst, No 18, pp 12-27, 1963.

Descriptors: *Rainfall-runoff relationships. Discharge (Water), *Hydrographs, Storm runoff, Surface runoff, Groundwater. Identifiers: *Calculations.

Hydrological observations; elements of transformation of precipitation to runoff are given on basis of diagram of hydrological cycle; methods used to determine discharge from rainfall are reviewed, with special attention to unit-hydrograph method for surface runoff; analytical method developed in Netherlands for calculation of groundwater discharge; behavior of flood wave in open channels is discussed W69-02273

CHARACTERISTICS OF THE INLET HYDRO-

W. Viessman, Jr., and J. C. Geyer. ASCE Proc, J of Hydr Div, Vol 88, No HY5, p 245,

Descriptors: *Rainfall-runoff relationships, *Intakes, *Rainfall intensity, Roughness (Hydraulic), Runoff, *Hydrographs. Identifiers: *Urban drainage, *Surface permeabili-

The results of a study of the relationship between rainfall and runoff for impervious inlet areas are presented. An attempt has been made to include as many significant variables as possible. Prominent among the latter were antecedent rainfall storm intensity and pattern, and size, slope, and roughness of the inlet areas. Data from records on impervious areas in Baltimore, Md., Newark, Del., and Hertfordshire, England. Equations for peak rates of runoff, rise of hydrograph, and method proposed for predicting shape of simple hydrograph. W69-02275

HYDRAULIC MODEL FOR CATCHMENT-STREAM PROBLEM. III. COM-PARISON WITH RUN-OFF OBSERVATIONS, R. A. Wooding.

J Hydrol, Vol 4, pp 21-37, 1966.

Descriptors: *Model studies, *Rainfall intensity, Discharge (Water), *Hydrographs, *Rainfall-runoff relationships, Drainage.

The application to field measurements of a hydraulic model of a V-shaped catchment draining into a stream situated in the apex of the V is discussed. together with the mode of determination of unknown parameters after choosing parameters for the rainfall intensity scale, catchment equilibrium time. the scale of the discharge hydrograph, and the ratio of stream-equilibrium time to catchment equilibrium time. Comparisons of discharge hydrographs calculated from the theoretical model are made with those from catchment areas at Cashmere, New Zealand, and at Alice Springs and Warragamba Dam, Australia. Improvements are suggested, including the need for a better geometrical description of the stream network in examples, and it is pointed out that a more efficient treatment of infiltration losses might be possible with a model based on stream networks. W69-02277

HYDRAULIC MODEL FOR CATCHMENT-STREAM PROBLEM,

R. A. Wooding.

J Hydrology, Vol 3, No 3-4, pp 254-82, 1965.

Descriptors: *Model studies, Discharge (Water), *Hydrographs, Rainfall intensity, *Rainfall-runoff relationships.

Analytical solutions for hydraulic model are obtained by method of characteristics, firstly, for flow over plane V-shaped catchment under constant uniformly-distributed rainfall of finite duration, and secondly, for stream outflow arising from catchment discharge predicted form of stream hydrograph is calculated numerically, assuming that rainfall is of constant intensity and of finite duration. W69-02278

WATER-OUR SECOND MOST IMPORTANT NATURAL RESOURCE.

Rensselaer Polytechnic Institute.

Donald B. Aulenbach.

Boston College Ind and Com L Rev, Vol 9, No 3, pp 535-552, Spring 1968. 18 p, 42 ref.

Descriptors: Chemical properties, Electrical properties, Compressability, Ionization, Surface tension, *Hydrologic cycle, *Rainfall runoff relationships, *Surface runoff, Evapotranspiration, Water balance, Groundwater, Recharge, Lakes, Desalination, Consumptive use, Water yield improvement, Distribution, *Economic feasibility.

The importance of water to man and its unique properties are summarized. In order to determine the supply of usable water an inventory of the earth's total supply is set forth in table I. 99.2% of the supply, comprised of salt water and glaciers, is virtually unusable. 98.3% of the remainder is groundwater, 50% of which is reasonably accessible. Stream runoff is the portion which is readily available to man. Presently there is an annual water use in the United States of 450 million acre feet per year with an average stream runoff of 1372 million acre feet per year. This potential supply is not necessarily unpolluted, however, although at present there is sufficient available water to meet demands. Tables are included with a breakdown of water uses showing a tenfold increase in the last 70 years with the greatest increases in power generation and industrial uses. Due to population increases and increased industry it is estimated that by 1980 water demands will exceed the amount of water readily available. Four methods are suggested for increasing the supply: desalting sea water; imports from areas of large supply; weather modification; and salvage measures. The feasibility of each is discussed. It is suggested that demand might be reduced by raising water prices. (Kahle-

W69-02332

Group 2A-General

THE EFFECTS OF URBANIZATION ON UNIT HYDROGRAPHS FOR SMALL WATERSHEDS,

HYDROGRAPHS FOR SMALL WATERSHEDS, HOUSTON, TEXAS, 1964-67, W. H. Espey, Jr., and D. E. Winslow. Rep by TRACOR, Sept 1968; Vol 1, Doc No 68-975-U, text, 70 p, 19 fig, 8 tab, 8 ref, Contract No. 14-01-0001-1580; Vol 2, Doc No 68-1006-U, append-data compilation, 244 p, many fig and map, 10 ref. OWRR Supported by Title 11, Water Passources Act 1964 Resources Act, 1964.

Descriptors: *Urbanization, *Storm runoff, *Rainfall-runoff relationships, *Unit hydrographs, Regression analysis, Drainage systems, Land use, Roads, Vegetation effects, Infiltration, Small watersheds, Environmental engineering. Identifiers: Linear regression analysis, Houston (Texas), Urban watersheds.

Rainfall-runoff relations were studied on several small watersheds in Houston, Texas, to learn the effects of urbanization and to develop equations to describe the effects of urbanization on unit hydro-graphs. Rainfall and runoff data from 11 urban and 6 rural watersheds were reduced and 30-minute unit hydrographs obtained. This was combined with previously reduced data for 22 urban and 11 watersheds. The Houston Urban Project of the USGS, WRD, provided most of the basic data. Multiple linear regression analysis was used to develop equations to describe the 30-minute unit hydrograph for urban and rural conditions. These equations were compared to previously derived equations and the equations of best fit were determined. The equations are used to predict effects on the unit hydrograph of changes in impervious cover, channel conditions and secondary drainage facilities due to urbanization. Applied to Houston watersheds they indicate that in changing from a rural to a highly urbanized condition the 30-minute unit hydrograph may show an increase in peak discharge of up to 500% and a decrease in time of rise of up to 90%. Appendices published in a separate volume contain unit hydrographs, descriptions and maps of the watersheds, basic hydrologic data, and equations developed by regression analysis. (Knapp-USGS) W69-02354

FLOW OF THE RIO GRANDE AND RELATED DATA - FROM ELEPHANT BUTTE DAM, NEW MEXICO TO THE GULF OF MEXICO - 1966. International Boundary and Water Commission, U. S. and Mexico.

For primary bibliographic entry see Field 02E For abstract, see . W69-02355

2B. Precipitation

DOUBLE-MASS ANALYSIS ON COMPUTER.

ASCE Proc, J Hydraulic Div, Vol 94, No HY 1, Paper 5729, pp 139-42, Jan 1968.

Descriptors: *Computer programs, *Precipitation. Identifiers: *Calculations.

Hydrologists use double-mass analysis to verify consistency of precipitation or streamflow record; precipitation of station is plotted against combined precipitation of surrounding stations; consistency of record is verified if single straight line fitted through points is reasonable; analysis is done on computer by fitting straight line and fourth-degree polynomial through points and comparing two sums of squares of deviations of points from fitted curves; if record is found to be inconsistent, it is adjusted by bringing deviated points along desired single straight line; method should be of value to hydrologists having access to computers. W69-02263

RAINFALL RATES OF HEAVY RAINS IN

W. Storch, and F. W. Boll. Gas-Wasserfach, Vol 109, No 6, pp 156-157, 1968.

Descriptors: *Rainfall intensity. Identifiers: *Calculations, *Bremen (Germany).

Recent measurements of the rainfall intensity-duration relationship, which the municipal authorities of Bremen, Germany carried out at four measuring stations, have shown that the rainfall intensity-duration curve used for years does not correspond to present conditions. The old value was in error of 67% for 25 minutes. A new rainfall intensity-duration curve was constructed using Hoerler's method, which provided the author with data that could be used to determine rainwater rates for rainfalls of any duration and frequency. The newly constructed curve not only differs greatly from the old data, but also disagrees with the Reinhold data so far accepted as valid for the whole northwestern part of Germany. W69-02269

STORM STUDIES IN SOUTH AFRICA-SMALL-AREA HIGH-INTENSITY RAINFALL,

W. van Wyk, and D. C. Midgley Civ Engr in South Africa, Vol 8, No 6, pp 188-97, June 1966.

Descriptors: *Rainfall intensity, *Design. Identifiers: South Africa.

Intensity-duration-frequency relationships, time distribution of intense rainfall, and areal distribution of rain within intense storms are dealt with; to enable relationships to be extended to ungaged localities, coaxial plot of intensity, duration, frequency, mean annual rainfall and rainfall region is presented; dimensionless curve is provided as basis for synthesizing mass curve of rainfall during 'design storm'; third diagram is presented as basis for determining isohyetal pattern of design storm; application to design is illustrated by example. W69-02274

ARIDITY DEFINITIONS AND THEIR APPLICA-BILITY

Swedish Meteorological and Hydrological Institute, Stockholm

C. C. Wallen.

Geografiska Annaler, Vol 49A, No 2/4, pp 367-384, 1967. 18 p, 4 fig, 2 tab.

Descriptors: Water balance, Climatic data, Arid climates, Semiarid climates, Investigations, *Climatology, Meteorology, *Equations, *Temperature, Precipitation, Evapotranspiration, *Rainfall. Identifiers: *Aridity, *Indices, Agricultural potential, Near East, Agroclimatology.

A review of the various approaches to the problem of defining aridity were given. The classical, Index, and water-balance approaches were discussed with particular emphasis on a critical analysis of the different indices developed by Koppen, deMartonne, Emberger, and Gaussen. In the latter part of the article a summary was given of an investigation, which was an attempt to establish from the available climatological information, the agricultural potentialities of the semi-arid and arid regions in the Near East. The countries involved were Lebanon, Syria, Jordan, Iraq, and Iran. The results from a purely classical approach were compared with an approximate determination of the waterbalance conditions based on Penman's formula. (Affleck-Ariz) W69-02384

2C. Snow, Ice, **AND Frost**

A PRELIMINARY ESTIMATE OF THE ICE-SEASON ENERGY BALANCE FOR THE NIAGARA RIVER,

Meteorological Service of Canada, Ontario, Hydrometeorology Section.

H. L. Ferguson.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 41-58, Sept 1968. 18 p, 2 fig, 9 tab, 20 ref.

Descriptors: *Heat budget, *Rivers, *Ice, *Climatic data, *Hydrologic data, Freezing, Melting, Radiation Identifiers: *Energy balance, Niagara River,

Canada

Part of a study by the Meteorological Service of Canada and the Ontario Hydro-electric Power Commission on ice formation and dissipation on the upper Niagara River is an estimated energy budget of the river, based on long term climatological data and on hydrological observations made in the 1967 ice season. The measured and estimated terms in the energy budget are net incoming radiation, net energy loss by evaporation, conduction to the atmosphere, loss by snowmelt, incoming advected energy, outgoing advected energy, and net gain in energy storage. Storage and advection are the most difficult to measure or accurately estimate. Ice forecasting methods by multiple-regression methods may be possible. Lack of precision in measurements of storage and advection terms limits the use of the energy budget equation as a direct ice-prediction method. (Knapp-USGS) W69-02335

2D. Evaporation and **Transpiration**

RAINFALL AND EVAPORATION: DISTRIBUTION IN SPACE AND TIME,

P. J. Meade.

J Inst Water Eng, Vol 21, No 3, pp 210-215, May

Descriptors: *Rain gages, *Data collections, *Rainfall intensity. Identifiers: Urban drainage.

The Meteorological Office is undertaking intensive research into the problems of the measurement, collection, and analysis of data on rainfall and subsequent evaporation to use in future planning of both water resources and water disposal. Water disposal problems requiring an accurate analysis of rainfall data include: urban drainage, rool drainage, protection of dams, embankments for railways and roads, etc. However, meteorologists are aware of another set of problems which must be attacked with determination if a comprehensive service of information and advice is to be provided in this field. These problems are concerned with the forecasting of rainfall, the time of onset, the duration, and the quantity that will fall; they range over a wide area of meteorology from the physics of clouds to the large-scale movements of the general circulation of the atmosphere.
W69-02247

SPRING TRANSPIRATION OF THREE DESERT SPECIES.

Nevada Univ., Reno, Nevada. Desert Research Institute. N. Stark

J Hydrol - Amsterdam, Vol 6, No 3, pp 297-305, June 1968. 9 pp, 3 fig, 1 tab.

Descriptors: *Transpiration, Desert plants Sagebrush, Rabbitbush, *Hygrometry, *Water loss. Arid climates, Growth rates, Lysimeters, *Leaves. *Spring, Weight, Data collections, Sun. Identifiers: Horsebrush, Hygrosensor, Dry leaf weight, Dry sites, Wet sites, Shade.

Transpiration rates of sagebrush, rabbitbrush and horsebrush were determined at a site north of Reno, Nevada. The techniques that were used explored the possibility of using the grams of water lost per gram of dry leaf weight as a basis for defin-ing transpiration rather than the conventional method of relating loss to leaf surface area. The method of relating loss to leaf surface area. The weight approach was being studied because it was impossible to accurately determine the surface area of many desert species. The hygrosensor area transpirometer used in the study made it possible to compare water loss from whole, living plants of the same species growing in close proximity on wet and

Streamflow and Runoff—Group 2E

dry sites in the field. Data which were not corrected for weight differences showed that sagebrush lost more water per plant per minute than did rabbit-brush on a dry site. Rabbitbrush transpired more rapidly on a dry site per gram of dry weight than did sagebrush. The dry weight of leaves was a more desirable reference for transpiration rate than was leaf area which was used for broad-leaved plants. (Blecker-Ariz) W69-02376

CONTROL OF LEAF STOMATA--THEIR ROLE IN TRANSPIRATION AND PHOTOSYNTHESIS, For primary bibliographic entry see Field 02I. For abstract, see . W69-02379

WATER LEVEL **FLUCTUATION** EVAPOTRANSPIROMETERS.

U. S. Geological Survey, Phoenix, Arizona. Water Resources Div.

T. E. A. Van Hylckama.

Water Resources Research, Vol 4, No 4, pp 761-768, Aug 1968. 8 p, 5 fig.

Descriptors: *Evapotranspiration, Diurnal, Heating, Cooling, Tidal effects, *Water level fluctuation, Tamarisk, *Instrumentation, *Fluctuation, Transpiration, *Atmospheric pressure, Tempera-

Identifiers: *Evapotranspirometers, *Tanks, Plastic lining.

The effects of diurnal variation due to daily heating and cooling of the air and semi-diurnal variations due to the tidal effects of the moon on water levels in eleven plastic lined evapotranspirometers were studied in Buckeye, Arizona. Eight of the tanks were planted to salt cedar and three were left bare. The levels of the artificially maintained ground water in these instruments showed distinct diurnal fluctuations. Such a response was thought to be due to either air bubbles in the saturated zone, or the flexible plastic lining of the tank. On vegetated tanks that were transpiring the water level and the barometric curves were out of phase but if the water levels were corrected for atmospheric pressure fluctuations a curve appeared that represented the hourly rate of water use. (Affleck-Ariz) W69-02382

USE OF ATMOMETERS IN ESTIMATING EVAPOTRANSPIRATION,

California Dept. of Water Resources, Sacramento,

John W. Shannon.

J. Irrig and Drain. Div ASCE. Vol 94, No IR3, Proc Paper No 6120. pp 309-320, Sept. 1968.

Descriptors: *Atmometers, Instrumentation, Evaporation, *Climatic data, *Evapotranspiration, Evaporation pans, Water requirements, Data col-lections, Energy, *Monthly, *Seasonal, Water loss. Identifiers: Evaporative demand, Crop coefficients.

Studies conducted by the California Department of Water Resources during the past 10 years show that Livingston black and white spherical atmometers provided a practical means of estimating monthly and seasonal evapotranspiration. The dif-ference of evaporation between the black and white atmometers was affected primarily by short wave energy, whereas evaporation from either the black or white atmometer provided an index of the total amount of energy available for evapotrans-piration. Various studies were made, the results of piration. Various studies were made, the results of which indicated that the type of background has little effect upon the difference in evaporation between the black and white atometers. Monthly crop coefficients were developed for some of the principal crops in the Central Valley of California, which provided evapotranspiration estimates consistently as good as or better than could be about the contraction. sistently as good as or better than could be obtained using coefficients developed from United States Weather Bureau Class A evaporation pan data. (Affleck-Ariz) W69-02387

GAS DIFFUSION POROMETER TECHNIQUE AND ITS APPLICATION TO THE MEASUREMENT OF LEAF MESOPHYLL RE-SISTANCE,

Hebrew Univ of Jerusalem, Dept. of Botany J. Gale, Alexandra Poljakoff-Mayber, and I. Kahane

Israel J Bot, Vol 16, No 4, pp 187-204, 1967, 18 p, 3 fig, 4 tab.

Descriptors: *Transpiration, Measurement, *Leaves, Pores, Gases, Absorption, Carbon dioxide, Diffusion, Photosynthesis, Plant physiology, Stomata, Equations, *Resistance, *Water vapor, *Water loss, Vapor pressure, Density. Identifiers: Air vapor density gradient, Mesophyll,

*Gas diffusion porometer, Porometers.

A critical study of the use of the diffusion porometer method for the evaluation of mesophyll resistance to water vapor loss was conducted by the authors. Apparently significant mesophyll resistance was found in maize leaves under conditions of low leaf to air vapor pressure gradients. Calculations showed that this resistance had a considerable effect on transpiration and on the estimation of mesophyll resistance to carbon dioxide uptake. Due to the considerable experimental error inherent in the technique, this finding should be treated with reservation. Negative values of mesophyll resistance were found in maize leaves subjected to high vapor pressure gradients and in beans even under conditions of low vapor pressure gradients. These results were ascribed to the development of a tortuosity resistance which was greater than the series sun of the internal resistances to diffusion from the separate sides of the leaf. (Affleck-Ariz) W69-02391

2E. Streamflow and Runoff

THE DESIGN OF STORM SEWERS.

For primary bibliographic entry see Field 04A. For abstract, see . W69-02178

SOLUTION FOR STORM SEWER SYSTEM PROBLEM,

L. E. McMahon.

Am Assn State Highway Officials-Committee on Electronics-Regional Conf on Improved Highway Eng Productivity, Chicago, Ill., pp VII-14-25, April 19-20, 1963.

Descriptors: *Computer programs, *Design, *Rainfall intensity, *Rainfall-runoff relationships. Identifiers: *Storm sewers.

Program was developed at Michigan State Highway Dept for solution of storm sewer system problem created by accelerated highway program; program is written for processing on 20 K IBM 1620 computer equipped with floating point and indirect addressing features; solution is based on use of 'Rational Method for Design of Storm Sewer Systems' Manning formula and use of rainfall intensity and runoff curves developed to meet Michigan's needs. W69-02186

STORM SEWER DESIGN FACTORS.

For primary bibliographic entry see Field 08A. For abstract, see . W69-02195

DESIGN OF STORM SEWER SYSTEMS,

L. H. Watkins.

Chartered Mun Engr, Vol 90, No 11, pp 337-41, Nov 1963.

Descriptors: *Design, *Rainfall-runoff relationships, *Computer programs.
Identifiers: *Storm sewers, *Urban drainage.

Research into relation between rate of rainfall and rate of runoff from urban areas; new method of calculating sewer sizes developed as result of research is described; programs for electronic digital com-puter have been evolved to enable method to be used simply and economically for designing new sewer systems and examining and redesigning existing systems. W69-02204

A LAKE'S RESPONSE TO ITS ENVIRONMENT. For primary bibliographic entry see Field 05C. For abstract, see . W69-02217

AN INVESTIGATION INTO INFILTRATION AND INTERCEPTION RATES DURING STORM RAINFALLS AND THEIR APPLICATION TO FLOOD PREDICTION,

For primary bibliographic entry see Field 08D. For abstract, see W69-02242

VARIATION OF RUN-OFF COEFFICIENT, K. J. Mawson.N Z Eng, Vol 14, 38, 1959.

Descriptors: *Drainage system, *Storm runoff, *Runoff forecasting, Storms, *Rainfall intensity, Identifiers: *Urban drainage, *Wellington (N.Z.).

At Wellington, N.Z., for about 30 years, stormwater drainage systems have been designed satisfactorily on the basis of the runoff-estimated by the rational method, which assumes that the highest peak flows from small catchments are produced by storms of the short-duration, high-intensity type, and generally makes no provision for prolonged falls of relatively low intensity. Data on the rainfall and floods in the residential suburb of Karori and in the bush-covered Wainui watersupply catchment area are presented and discussed with particular reference to the behavior of the run-off coefficient. It is concluded that the shortperiod high-intensity type of storm does not produce peak floods as high as those attained in longer storms of more moderate intensity, and that the rational method is valid for designing drainage systems for the prolonged type of storm. The runoff coefficient can be calculated with reasonable accuracy by the method in the 'Provisional Standard' of the Soil Conservation and Rivers Control Council, N. Z.

EFFECTS OF CLIMATOLOGIC AND BASIN CHARACTERISTICS ON ANNUAL RUN-OFF, S. E. Mustonen. Wat Resour Res, Vol 3, pp 123-130, 1967.

W69-02246

Descriptors: *Runoff forecasting, Surface runoff. Identifiers: *Calculations, Surface permeability, Finland.

Regression analysis was used to select climatological and basin characteristics affecting the annual run-off in Finland. Seasonal precipitation and mean annual temperature were found to be much more important than basin characteristics such as soil type and vegetation; frost depth was inversely related to run-off; while percentage areas of cultivated land and peat land were not significant factors. The statistical methods used are explained and discussed W69-02248

METHODS OF DETERMINING SURFACE DIS-TRIBUTION OF EXCESSIVE RAINFALLS,

Int Geodetic and Geophysical Union-Sec for Sci Hydrology Publ No 65 pp 303-8, 1964.

Descriptors: Rain gages, *Rainfall intensity, Sur-

Field 02—WATER CYCLE

Group 2E-Streamflow and Runoff

Identifiers: *Calculations.

Investigation of surface distribution of heavy rainfalls in area of four largest towns in Czechoslovakia using rain gaging data of 25 yr period 1925-1949; two basic characteristics determined for rainfalls were relation between maximum intensity of total rainfall in mm/min and its duration in place of maximum intensity in minute; equation of horizontally diminishing intensity of heavy rainfalls was determined empirically. W69-02251

COMPARISON OF SOME FORMULAS FOR DETERMINING THE SNOW MELT (PRELIMI-NARY RESULTS),

N. Rachner.

Wasserwirtsch-Wassertech, Vol 18, No 1, pp 10-12, Jan 1968.

Descriptors: *Snowmelt, *Runoff forecasting, *Discharge (Water), Flood control. Identifiers: *Calculations.

Run-off forecasts, especially the snow-melt water discharge prognoses, gain continuing significance in flood prevention and water management. To present a survey of possible methods and, simultaneously, to show the order of magnitude of ommissions pertaining to the simpler methods, a selection and comparison of various formulas found in the literature is made. The statements are illustrated by examples. W69-02252

SURFACE-WATER HYDROLOGY OF CALIFORNIA COASTAL BASINS BETWEEN SAN FRANCISCO BAY AND EEL RIVER, S. E. Rantz, and T. H. Thompson

U S Geol Survey-Water Supply Paper 1851, 1967. 60 pp, map.

Descriptors: *Surface runoff, Planning. Identifiers: California.

Hydrologic information for use in project planning by California Department of Water Resources and other water agencies operating in State; study of runoff regimen indicates that, for any stream, there is close relationship between flow-duration curve and frequency curves for low flows of various durations; magnitude and frequency of high flows, for durations ranging from 1 day to 274 days, were analyzed by method that closely paralleled that used in flood-frequency study. W69-02253

LONG-RANGE FORECAST OF CRITICAL DATES OF SPRING DISCHARGE HYDRO-GRAPH FROM LOCAL INDICES OF ATMOSPHERIC CIRCULATION,

M. V. Rudometov.

Am Geophysical Union. Soviet Hydrology-Selected Papers, No 1, pp 31-46, 1964.

Descriptors: *Runoff forecasting, *Flood forecasting, *Hydrographs, Discharge (Water). Identifiers: Russia.

Methods of long-range forecasting of dates of beginning of spring high water and dates of onset of maximum discharge based on use of local indices of atmospheric circulation, taking Desna River at city of Chernigov in Ukraine as example. W69-02256

MAGNITUDE AND FREQUENCY OF STORM RUNOFF IN SOUTHEASTERN LOUISIANA AND SOUTHWESTERN MISSISSIPPI, V. B. Sauer. U S Geol Survey-Prof Paper 501-D, pp 182-4,

1964

Descriptors: *Storm runoff, Storms, Discharge Identifiers: *Calculations.

Graphical correlations indicate that mean annual, .33-yr, storm runoff for any site in area is 64 sec-fi-days/sq mi, which is equivalent to uniform depth of 2.38 in.; recurrence interval of individual storm runoff will, in many instances, be significantly different from recurrence interval of peak discharge resulting from same storm. W69-02257

SYNTHESIS OF INLET HYDROGRAPH.

J. C. Schaake, Jr. Johns Hopkins Univ-Dept Sanit Eng and Water Resources-Tech Report 3, June 1965, 105 p.

Descriptors: *Hydrographs, *Intakes, *Surface runoff, Storms, *Computer programs, *Drainage systems Identifiers: Calculations, Surface permeability,

Method is presented for synthesizing hydrograph of runoff from paved portions of drainage area; method involves application of equations of gradually varied unsteady flow in open channels to describe mechanics of surface runoff; method of synthesizing inlet hydrograph will provide means for developing records of runoff for inlet areas of sufficient length to have statistical significance; advantage of method is that drainage area behavior can be simulated on computer so response of area to arbitrary or spatially varied rainfall can be accurately predicted. W69-02258

EXPERIMENTAL EXAMINATION OF RA-TIONAL METHOD,

J. C. Schaake, Jr., J. C. Geyer, and J. W. Knapp ASCE Proc, J Hydraulics Div, Vol 93, No HY 6, paper 5607, pp 353-70, Nov 1967.

*Rainfall-runoff relationships. Drainage, Runoff, *Rainfall intensity, Storm ru-

noff, Design. Identifiers: *Calculations, *Urban drainage, Baltimore (Md.).

Rainfall and runoff data collected in Baltimore, Md, from 20 gaged urban drainage areas ranging in size up to 150 acres have been used in study of Rational Method; results suggest that frequency of oc-currence of computed design peak runoff is same as frequency of occurrence of rainfall intensity selected by designer with appropriate C; in accordance with their usual design procedures, five storm drainage designers used Rational Method to estimate 5 yr design peak runoff rates for six gaged drainage areas; these values are compared with runoff values from runoff frequency curves for these gaged areas. W69-02259

USE OF ANALOG MODELS IN ANALYSIS OF FLOOD RUNOFF,

US Geol Survey-Prof Paper 506-A, 1965. 24 p.

Descriptors: *Computer programs, *Flood forecasting, Runoff.

Quasi-linear analog model has been developed for simulating runoff-producing characteristics of drainage system; where storage is linear unique relationship correlating inflow and outflow peaks is derived; technique for synthesizing flood-frequency distribution is also proposed, whereby effects of linear- or nonlinear-basin system upon its inflow probability distributions are examined. W69-02261

NON-LINEAR INSTAN HYDROGRAPH THEORY, **INSTANTANEOUS** UNIT-

K. P. Singh. ASCE Proc, J Hydr Div, Vol 90, No HY2, Paper No 3852 pp 313-347, 1964.

Descriptors: *Hydrographs, *Storms, *Surface ru-Identifiers: *Calculations.

A theory has been developed, using a non-linear approach, to account for the apparent variations in instantaneous unit hydrographs derived from dif-ferent storms over a given drainage basin. Excess rainfall with a non-uniform areal and time distribution is transformed to a direct surface run-off hydrograph at the basin outlet, with consideration of the effect of both overland and channel flows. The characteristics of such flows vary from place to place in any drainage basin, and their effects on the instantaneous unit hydrograph are considered in terms of the translation and storage factors of these flows over the basin. Analyses of storms over 6 drainage basins gave consistent results, indicating that the proposed equation can be used satisfactorily for instantaneous unit hydrographs. W69-02262

BASIC GEOGRAPHICAL AND HYDROCHEMI-CAL CHARACTERISTICS OF LOCAL RUNOFF OF NATURAL ZONES IN EUROPEAN TERRITORY OF USSR,

B. G. Skakal'skiv.

Soviet Hydrology-Selected Papers, No 4, pp 389-434, 1966.

Descriptors: *Precipitation, *Surface runoff, Groundwater, *Hydrographs, Discharge (Water).

Consideration is given to physiographic conditions of formation from atmospheric precipitation, falling on surface of catchments, of waters of various origin that make up local runoff; volumes of waters of various origin (surface-slope, soil-surface, topsoil-ground and ground-water) are determined by genetic separation of discharge hydrographs of small rivers; on basis of material thus obtained, quantitative description is given of genetic categories of runoff developing in specific hydrologic periods on small catchments for year of average hydrometeorological conditions, and their zonal features are established. W69-02264

PERCOLATION, **GROUND-WATER** DISCHARGE, AND STREAM FLOW IN THE NIDD VALLEY,

K. J. Smith.

J Instn Water Engrs, Vol 20, pp 459-471, 1966.

Descriptors: *Groundwater, *Discharge (Water), Drainage, Rain, *Runoff, *Rainfall-runoff relation-

Identifiers: Calculations, Surface permeability

Records of drainage, taken from a percolation gauge at Harlow Hill, near Harrogate, Yorks., were compared with values for stream flow, rainfall and run-off in the Nidd valley, Yorks., at 2 catchment areas, Hunsingore and Howstean. It was found that the response of percolation to rainfall was similar to that of run-off to rainfall, and this was particularly marked if mean values were taken over a long period. Statistical analysis showed that the relation between run-off and measured drainage was closest during winter and autumn, with correlation coefficients of 0.87 and 0.86 respectively; on the other hand there was a large discrepancy between infiltration at Hunsingore and measured drainage at Harlow Hill. It was concluded that the percolation gauge is not a satisfactory instrument for measuring effective infiltration and that results obtained from it should be compared with run-off characteristics when the gathering grounds are relatively impermeable. W69-02265

NOMOGRAMS FOR THE DETERMINATION OF ANTICIPATED WATER DISCHARGE IN PLANNING RAIN RUN-OFF SYSTEMS, A. N. Sorokin. Vodosn Sanit Tekh, No 5, pp 12-14, 1960.

Descriptors: *Runoff forecasting, *Design. Identifiers: Calculations, *Storm sewers.

Streamflow and Runoff—Group 2E

Equations and nomograms are given for estimating the amount of run-off to be allowed for when designing storm-water sewers. W69-02268

RELATIONSHIP BETWEEN SURFACE AND UNDERGROUND WATERS AND USE OF WELL **OBSERVATIONS IN RIVER-FLOW FORECAST-**ING.

A. I. Subbotin.

Int Geodetic and Geophysical Union-Sec for Sci Hydrology Publ No 63, pp 513-19, 1964.

Descriptors: *Surface runoff, *Subsurface runoff, Discharge (Water), *Rainfall-runoff relationships. Identifiers: Russia.

Analysis of relations between groundwater level and low-water flow or minimum discharge on several Russian rivers; storm runoff-rainfall relationships. W69-02270

HYDROLOGIC RECONNAISSANCE OF POINT REYES NATIONAL SEASHORE CALIFORNIA, AREA.

U S Geological Survey R. H. Dale, and S. E. Rantz.

U S Geol Surv Open-file report, 37 p, 1966. 16 fig.

Descriptors: *Water resources, Surface waters, *Groundwater, *National seashores, *California, Hydrogeology, Water wells, Streamflow, Water quality, Springs, Water yield, Water demand. Identifiers: Point Reyes National Seashore.

The water resources of Point Reyes National Seashore were investigated to appraise sources of water supply at park sites where visitor accommodations are proposed. Point Reyes is a peninsula on the California coast 50 mi N of San Francisco. Its altitude ranges from sea level to 1,400 ft. Precipitation is seasonal; 75% of the 20-40 in. is in Nov through March. Runoff ranges from 6-16 in. About 90% of the runoff is in Dec through April when demand is at its minimum. Summer stream-flow is inadequate at beaches in the northern part of the area and adequate at all other proposed visitor centers. Small groundwater supplies less than 25 gpm, can be developed at most sites from terrace sand and gravel deposits. The quality is generally good but iron content maybe high enough to cause problems. (Knapp-USGS) W69-02279

QUALITY OF SURFACE WATERS OF THE UNITED STATES 1960--PARTS 7 AND 8: LOWER MISSISSIPPI RIVER BASIN AND WESTERN GULF OF MEXICO BASINS. U. S. Geological Survey.

U S Geol Surv Water-Supply Pap 1744, 548 p, 1968. 1 fig, 33 ref.

Descriptors: *Data collections, *Surface waters, *Water quality, *Mississippi River Basin, Discharge (Water), Hardness (Water), Dissolved solids, Suspended load, Conductivity. Identifiers: Gulf of Mexico River Basins.

The surface water quality data of the Lower Mississippi River Basin and the Western Gulf of Mexico Basins for 1960 are tabulated. The records are arranged by drainage basins in downstream order. Daily and monthly samples were collected at 178 of 195 stations for chemical analysis. Temperature was measured daily at 103 stations. Suspended sediments were measured at 22 stations. Chemical analysis reports include station location, drainage area, available records, extremes, dates of collection, discharge, concentrations of silica, Fe, Cd, Mg, Na, K, Bicarbonate, carbonate, sulfate, C1, F, Nitrate, B, Total solids, hardness, SAR, conductance, and pH. (Knapp-USGS)

APPRAISAL VALLEY WATER-RESOURCES OF MESQUITE-IVANPAH VANEVADA AND CALIFORNIA, AREA,

U. S. Geological Survey, Carson City, Nev., Water Resources Div.

Patrick A. Glancy.

Nev Dep of Conserv and Natur Resources, Water Resources - Reconnaissance Serv Rep 46, 57 p, June 1968. 2 fig, 1 plate, 2 photo, 18 tab, 34 ref.

Descriptors: *Water resources, *Groundwater, *Nevada, Surface waters, Aquifers, Water yield, Rainfall, Recharge, Discharge (Water), Evapotranspiration.

Identifiers: Mesquite-Ivanpah Valleys (Nevada).

A reconnaissance survey was made of the Mesquite-Ivanpah Valley area which includes 4 valleys in southern Nevada with a total area of about 830 sq mi. All the groundwater recharge is from precipitation. Total runoff is estimated to be 2,100 acre-ft per year. Estimated annual precipitation is 430,000 acre-ft and recharge is 3,100 acre-ft, less than 1% of precipitation. The known and developed aquifers are in the valley fill alluvium but abundant carbonate rocks are probably a significant aquifer system. Discharge in Mesquite Val-ley is by evapotranspiration but in the other valleys it is apparently by subsurface outflow. Water quality ranges from good near recharge areas to very poor near discharge areas and at great depth. Present use in Mesquite Valley is about half the estimated perennial yield and in the other valleys it is less than 10% of estimated perennial yield. (K-napp-USGS) W69-02340

EFFECT OF DROUGHT ON STREAM QUALI-TY IN NEW JERSEY,

U. S. Geological Survey, Trenton, New Jersey. Peter W. Anderson, and John E. McCall. ASCE Proc, J Sanit Eng Div, Vol 94, No SA 5, Pap 6138, pp 779-788, Oct 1968. 10 p, 8 fig, 1 tab, 7

Descriptors: *Droughts, *Water quality, *Surface waters, *New Jersey, Streamflow, Biochemical oxygen demand, Turbidity, Dissolved solids, Dissolved oxygen, Saline water intrusion.
Identifiers: *Drought effects, Tidal-saline inva-

sions, Delaware estuary.

The drought of 1961-1966 was studied to learn its effect on water quality in New Jersey streams. The cumulative departures of precipitation and streamflow and use of 12-month moving average analysis of water quality information showed a definite relation of water quality to water deficiency. Abnormally high dissolved solids contents, coliform bacteria counts and BOD occurred as well as abnormally low dissolved oxygen and suspended sediment content and further than usual intrusion of saline water into estuaries. The maximum effect of drought was observed in late 1965 and early 1966. Some effects, such as low streamflow, were still observable a year after the drought ended. (Knapp-W69-02352

THE EFFECTS OF URBANIZATION ON UNIT HYDROGRAPHS FOR SMALL WATERSHEDS, HOUSTON, TEXAS, 1964-67,

For primary bibliographic entry see Field 02A. For abstract, see W69-02354

FLOW OF THE RIO GRANDE AND RELATED DATA - FROM ELEPHANT BUTTE DAM, NEW MEXICO TO THE GULF OF MEXICO - 1966. International Boundary and Water Commission, U. S. and Mexico.

Int Boundary and Water Comm, U S and Mex, Water Bull No 36, 155 p, 1967. 2 map.

Descriptors: *Data collections, *Surface waters, *Discharge (Water), *Water quality, *Rio Grande, Gaging stations, Reservoirs, Irrigation.

Identifiers: International Boundary and Water Commission (U S-Mexico).

Stream discharges and related data of the international part of the Rio Grande are presented. The streamflow data tabulated include gaging station description, period of record, descriptions of manmade changes in flow affecting the river near each station, mean daily discharge, and calculated extreme and average flow for the year and the period of record at each station. Diversions and stored water records are listed. Chemical quality data include suspended silt, chemical analyses, electrical conductivity, salt load, and sanitary aspects of quality. Climatological data listed include rainfall in the Rio Grande Basin, rainfall on subdivisions of the basin, location of rainfall stations, evaporation, temperature, humidity, wind, basin area above each gaging stations, and irrigated areas influencing streamflow at each gaging station. (Knapp-USGS) W69-02355

EFFECTS OF CYCLONE BEULAH ON THE YU-CATAN PENINSULA (SPANISH), Edmundo Hernandez Serrano.

Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 181-188, 1968. 8 p, 1 map, 12 photo.

Descriptors: *Floods, *Hurricanes, *Tropical cyclones, *Flood damage, *Economic impact, Storm runoff, Precipitation excess, Winds. Identifiers: *Mexico, *Yucatan F *Yucatan Peninsula, *Cyclone Beulah.

Some lasting effects of tropical cyclone Beulah in Mexico are reported. The second tropical disturbance formed in the Atlantic in 1967, Beulah, entered the Yucatan Peninsula the evening of September 16 with winds of 180 kph and torrential rains. The hurricane destroyed 90% of the rural dwellings on the Peninsula, crops valued at 50 million pesos and other agricultural facilities amounting to 15-1/2 million pesos, in addition to destroying or damaging livestock and forests. Fishing activities were disrupted for over 30 days resulting in losses to the economy of 5 million pesos. Total in-habitants suffering from Beulah's effects reached 17,000 in urban areas and 60,000 in rural areas. (Llaverias-USGS) W69-02359

FLOODS CAUSED BY CYCLONE BEULAH (SPANISH).

Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 203-212, 1968. 10 p, 17 photo, 2 maps.

Descriptors: *Hurricanes, *Tropical cyclones, *Floods, Diversion structures, Watershed management, Flood damage, Flood control, Routing, Hydraulic structures.

Identifiers: *Lower Bravo River Basin, *Cyclone Beulah, *Mexico, Hurricanes.

A summary is given of the report prepared by the special Commission appointed to collect damage data from the Beulah hurricane, especially flood damage to hydraulic structures on the lower San Juan and Bravo Rivers. The freshet peak of the Alamo reached the Bravo River on Sept 22, 1967, with a flow volume of 2,500 cu m/sec. Flow of the San Juan River was regulated by incorporating the excess water at the retention reservoir of the Gomez Dam. A maximum discharge of 4,910 cu m/sec flowed through the spillway. Overflows of the San Juan River produced flooding of the Irrigation District of the Lower San Juan and the town of Camargo. Water diversions at 3 points aided in flood control at Progreso. Water from Progreso reached San Raefael where it was diverted through the relief canals from 900 to 1,000 cu m/sec toward the Culebron retention reservoir. Three cuts to release water were made downstream from San Rafael. The top of the flood continued to Matamoros with a maximum flow volume of only 445 cu m/sec. From experience gained with Beulah, it is considered possible to control similar

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floods more effectively with proper utilization of retention reservoirs and controls. Recommendations are made by the Commission for projects to be planned by the International Commission for Limits and Waters. (Llaverias-USGS) W69.07361

END OF CYCLONE BEULAH, MEXICO (SPANISH),

Jenaro Paz Reyes

Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 189-194, 1968. 6 p, 4 graphs, 1 map.

Descriptors: *Hurricanes, *Tropical cyclones, *Flood damage, Flow control, Dams, Precipitation excess, Hydrographs, Texas, Tornadoes, Hydraulic structures, Winds.

Identifiers: *Mexico, *Cyclone Beulah, Rio Grande Basin, Mission Relief Canal, Anzalduas dam.

Cyclone Beulah, classified as the third most destructive hurricane in Texas, passed between Nueon Laredo and the Falcon Dam leaving floods in a wide zone across the Rio Grande basin and adjacent areas in Mexico and Texas in September 1967. In generating 85 tornadoes, it broke all records. The strong winds and tides caused great damage, but the torrential rains were the most devastating aspect of the storm which caused floods in all streams and rivers in Texas, south of San Antonio, and in Mexico, North of Monterrey. Flow volumes varied in the Bravo River (Rio Grande) from 6,225 cu m/sec at Fort Ringgold, Texas, to 400 cu m/sec at the gaging station below Brownsville. Relief basins in Mexico and the United States were used to obtain this reduction. The Mission Relief Canal in the U S helped divert the turbulent waters from the Lower Bravo River. The international Anzalduas Dam was also used to lower the water level and reduce flooding hazards for several cities along the lower reaches of the Rio Grande. (Llaverias-USGS) W69-02364

WATER RESOURCES DATA FOR ALABAMA, 1967--PART 1: SURFACE WATER RECORDS. U. S. Geological Survey, University, Ala., Water Resources Div.

Water Resources Div, U S Geol Surv, Part 1, 164 p, 1967. 2 fig.

Descriptors: *Data collections, *Surface waters, *Alabama, Discharge (Water), Gaging stations. Identifiers: Periodic observations.

Surface-water records for the water year ending Sept 30, 1967, for gaging stations, partial-record stations, and miscellaneous sites in Alabama are compiled. Each record included location, drainage area, records available, type and history of gages, average discharge, extremes of discharge, and general remarks as well as the daily record of mean gage height, monthly summary discharge, maximum and minimum daily discharge, and yearly summary. (Knapp-USGS)
W69-02365

DISPERSION PREDICTIONS IN NATURAL STREAMS.

U. S. Geological Survey and California Univ., Berkeley. For primary bibliographic entry see Field 05B.

For abstract, see . W69-02368

THE EFFECT OF REDUCTION IN STREAM FLOW ON INVERTEBRATE DRIFT,

Idaho State Univ., Pocatello, Dept. of Biology. G. Wayne Minshall, and Parley V. Winger. Ecology, Vol 49, No 3, Late Spring, 1968. 3 p, 1 tab, 12 ref.

Descriptors: *Streamflow, *Benthic fauna, *Aquatic drift, Streams, Management, Midges,

Mayflies, Invertebrates, Idaho, Indicator organisms, Caddisflies, Stoneflies.

Identifiers: Stream management, Experimental design, Targhee National Forest, Stratiomyidae, Limnephilidae, Black flies, Simulium, Baetis, Ameletus, Cinygmula, Ephemerella, Spring Run Creek, Trichoptera, Dugesia, Neothremma, Dixa, Pericoma, Rhyacophila, Nemoura.

Artificial reduction of discharge of Spring Run Creek (Targhee National Forest, Idaho), to 25% of initial depth and to 44-68% of initial velocity, resulted in increases in numbers of benthic invertebrates in the drift. Forms represented included midges (Chironomidae), several genera of mayflies (Baetis, Ameletus, Cinygmula, Ephemerella), black fly larvae (Simulium), and caddisfly larvae (family: Limnephilidae). A noteworthy observation was the appearance in the drift of large numbers of the triclad flatworm Dugesia, a species not commonly found among drift organisms. Exceptions to the trend of increased numbers with reduced flow occurred in only a few taxa. Changes in current velocity and depth in the stream apparently reversed normal avoidance responses by the benthic organisms to light, and, in many instances, they entered the drift in an active and directed manner as a result of their altered behavioral patterns. Author discusses importance of these data for stream management practices and for con-sideration of experimental design in studying drift. W69-02372

2F. Groundwater

HYDROLOGIC RECONNAISSANCE OF POINT REYES NATIONAL SEASHORE AREA, CALIFORNIA,

U S Geological Survey. For primary bibliographic entry see Field 02E. For abstract, see . W69-02279

GEOCHEMICAL STUDY OF GROUND WATERS IN THE MATSUSHIRO AREA-PART 2: CHEMICAL COMPOSITION OF GROUND WATERS.

Kyoto Univ., Kyoto, Japan, Disaster Prevention Research Institute.

Yasushi Kitano, Ryuma Yoshioka, and Setsuo

Okuda.

Bull of Disaster Prev Res Inst, Vol 18, Part 1, No 132, pp 49-58, July 1968. 10 p, 7 fig, 8 ref.

Descriptors: *Groundwater, *Water quality, *Water yield, *Springs, *Earthquakes, Landslides, Calcium, Chlorides. Identifiers: Japan.

A hydrological and chemical study of groundwater in the Matsushiro area, Japan, was made in 1966-1968 to learn the relationships between earthquake activity and groundwater quality and movement. Several large springs started flowing after the 1966 earthquakes. Some later stopped but several are still flowing. Increases in spring discharge do not follow precipitation increases, probably because the spring sources are deep. Calcium and chloride concentrations increase with earthquake activity. Discharge hydrographs of the major springs are included. Concentrations of the major ions are plotted against time. (Knapp-USGS)

GROUND-WATER HYDROLOGY AND GEOLOGY OF THE LOWER GREAT MIAMI RIVER VALLEY OHIO,

U. S. Geologocal Survey. Andrew M. Spieker. U S Geol Surv Prof Pop 605-A, pp A1-A37, 1968. 8 fig, 2 plate, 10 tab, 47 ref.

Descriptors: *Groundwater, *Induced infiltration, *Glacial drift, *Ohio, Water pollution, Water yield, Water quality, Water wells, Water level fluctuations, Water sources, Hydrogeology.

Identifiers: Great Miami River, Hamilton (Ohio), Davton.

The groundwater resources and geology of the Lower Great Miami Valley, Ohio, were studied to determine their adequacy to meet projected population and industrial needs. The valley is one of the most productive sources of groundwater in the U. S. A buried valley averaging 2 mi wide and 150-200 ft deep, filled with permeable sand and gravel Pleistocene outwash, follows the present course of the Great Miami River. The most favorable groundwater development areas are where 150 or more ft of sand and gravel with no clay layers are recharged at rates of 400,000 gpd per acre or more by induced infiltration. Yields may be as high as 3,000 gpm. Sewage return to the stream keeps streamflow high where induced infiltration would otherwise lessen it, and makes possible continued high pumping rates which are limited mainly by increased cost of treating water of deteriorated quali-River discharge at Hamilton exceeds 490 cfs 90% of the time; ample water is available for induced infiltration. Pumpage, mostly near the area's larger cities, totaled 110 mgd in 1964. Most of the groundwater of the area is untapped. Water levels are 30-50 ft below the surface and fluctuate 5-15 ft annually with highs in winter and spring. The groundwater is hard with total dissolved solids of 400-450 mg/1. The river is contaminated by organic and industrial wastes. Groundwater contamination is not yet a problem. (Knapp-USGS) W69-02337

QUATERNARY AQUIFERS IN THE MISSISSIP-PI EMBAYMENT,

U. S. Geological Survey.

E. H. Boswell, E. M. Cushing, and R. L. Hosman. U S Geol Surv Prof Pop 448-E, pp E1-E15, 1968. 15 p, 8 fig, 2 plate, 5 tab, 60 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Quaternary period, *Gulf Coastal Plain, Mississippi River Basin, Water yield, Water quality, Water utilization, Aquifer characteristics, Water levels, Water level fluctuations. Identifiers: Mississippi Embayment.

Alluvial deposits of Quaternary age form one of the most productive groundwater reservoirs in an area of about 45,000 sq mi in the Mississippi embayment. Also hydrologically important is the Red River Valley alluvial aquifer in Arkansas, Louisiana, and Texas. The alluvial aquifers are desirable sources of water for irrigation and industry. They are used for public supplies only where an ample supply of water of better quality is not available from deeper aquifers. Water from the alluvial aquifers is generally a hard to very hard calcium bicarbonate or calcium magnesium bicarbonate type containing excessive iron. Water temperature ranges from 59 deg F in the northern part of the embayment to 68 deg F in the southern part. Most industrial and irrigation wells are less than 150 ft deep. Wells yielding 500 gpm or more are common over more than 90% of the Mississippi River alluvial plain, and yields of more than 5,000 gpm have been reported. Water levels are generally less than 20 ft below the land surface. The amount of water stored in the Quaternary deposits is slightly more than 120 trillion gal. Withdrawals in 1965 averaged about 1,430 million gpd. About 85% of this amount was seasonal pumpage for irrigation. Water level declines of 20-30 ft are usual in the areas of large withdrawal but water levels generally recover to near normal each year. (Author)

WATER-RESOURCES APPRAISAL OF MESQUITE-IVANPAH VALLEY AREA, NEVADA AND CALIFORNIA,

U. S. Geological Survey, Carson City, Nev., Water Resources Div. For primary bibliographic entry see Field 02E. For abstract, see.

W69-02340

SIMPLIFICATIONS OF GROUND-WATER DATA USED FOR AN ANALOGUE OF A COASTAL AQUIFER,

Research Water Assoc., Medmenham. Buckinghamshire, England. For primary bibliographic entry see Field 07C. For abstract, see .

W69-02344

GROUND WATER IN THE REPUBLICAN RIVER AREA, CLOUD, JEWELL, AND REPUBLIC COUNTIES, KANSAS,

U. S. Geological Survey, Lawrence, Kansas, Water

Resources Division.

Kans State Geol Surv Bull 188, 27 p, 1968. 14 fig, 4 plate, 3 tab, 23 ref.

Descriptors: *Water resources, *Groundwater, *Kansas, Irrigation, Alluvium, Water wells, Water yield, Water utilization, Saline water, Municipal water, Domestic water, Stock water, Transmissivity, Permeability, Aquifers.

Identifiers: Water availability, Republican River, Cloud County (Kansas), Jewell County (Kansas),

Republic County (Kansas).

The groundwater resources of the Republican River area in Cloud, Jewell, and Republic Coun-Kansas, are described. Information is presented on the interrelationship between river and ground waters, the chloride content of the water and its areal pattern, and water-level fluctuations. Because surface water as well as groundwater is used for irrigation in the area, high water levels are found in some irrigated upland areas. In the lower areas, wells in alluvial deposits yield as much as 1,400 gpm. The annual pumpage in the area is about 12,300 acre-ft. Induced recharge from the Republican River is estimated to account for 710 acre-ft. Recharge from precipitation is estimated to be 0.6 in. Losses to evapotranspiration are estimated to be less than 0.2 in. In parts of northern Cloud County, chlorides may make groundwater unfit for irrigation. There is little yearly change in salinity, which is as high as 13,750 ppm in 1 well. Depth to water, contours on the water table, well locations, saturated thickness, and areas of salinity high enough to be dangerous for irrigation are mapped. Permeabilities and transmissibilities were estimated from pumping tests. Hydrographs of observation wells and the Republican River are included. (Knapp-USGS) W69-02345

PERMEABILITY OF SAND WITH DISPERSED CLAY PARTICLES,

Mississippi State Univ., State College. Keith H. Denson, Adnan Shindala, and Charles D. Fenn

Water Resources Res, Vol 4, No 6, pp 1275-1276, Dec 1968. 2 p, 1 fig, 2 tab.

Descriptors: *Permeability, *Sands, *Kalinite, *Montmorillonite, *Laboratory tests.

Experiments on sand containing varying amounts of montmorillonite and kaolinite show that contents of montmorillonite over 3% reduce effective permeability to water by 100% for sands with a grain size distribution with a mean of 0.30 mm and standard deviation of 0.18 mm. Kaolinite over 16% reduces the permeability of similar sands to practically 0. Losses of permeability of the sand samples with clay contents of 0-10% are tabulated. Permeability of the pure sand used is 0.1082 cm/sec. Only 1% montmorillonite is needed to reduce permeability by 82%. (Knapp-USGS) W69-02347

A MATHEMATICAL MODEL FOR TRANSIENT FREE SURFACE FLOW IN NONHOMOGENE-OUS OR ANISTROPHIC POROUS MEDIA, Acres Ltd., Niagara Falls, Canada. For primary bibliographic entry see Field 07C.

For abstract, see. W69-02353

ELECTRIC-ANALOG STUDIES OF BRINE CONING BENEATH FRESH-WATER WELLS IN THE PUNJAB REGION, WEST PAKISTAN, U. S. Geological Survey.

G. D. Bennett, M. J. Mundorff, and S. Amjad

U S Geol Surv Prof Pop 1608-J, pp J1-J31, 1968. 31 p, 12 fig, 1 plate, 1 tab, 5 ref.

Descriptors: *Saline water-freshwater interfaces, *Saline water intrusion, *Pumping, Water pollution sources, Analog models.

Identifiers: Punjab (West Pakistan), Skimming

A graphical procedure developed to deal with the problem of water coning beneath an oil well was used to study the coning of saline water beneath a fresh-water well with uniform areal recharge. The head distribution employed in this technique was from an analog model for steady-state axisymmetrical flow. Through a technique of successive approximation, the lower boundary of the model was adjusted to simulate the highest stable position of the brine cone in each of 18 different experiments. Flownets were constructed from the analog results for each experiment. The series of experiments represented 6 screen penetrations at each of 3 values of a parameter representing the thickness of fresh water at the radius of influence of the well, the lateral permeability, and the vertical permeability. Dimensionless functions yielding the drawdown and discharge of the well when the brine cone is in its highest stable position were calculated from the results of each experiment. Applied to conditions in the Pinjab Region of West Pakistan, the results indicate that prospects are good for the development of wells capable of yielding fresh water above a stable cone in the underlying brine or brackish water. (Author) W69-02362

2G. Water in Soils

SOIL WATER RECHARGE DURING THE DOR-MANT PERIOD IN THE NORTHWEST CORN RELT.

Agricultural Research Service, Morris, Minn., North Central Soil Conservation Research Center. D. R. Timmons, and R. F. Holt. J Soil and Water Conserv, V 23, No 5, pp 177-180, Sept-Oct 1968. 4 p, 5 fig, 2 tab, 12 ref.

Descriptors: *Recharge, *Soil moisture, *Prairie soils, South Dakota (Minnesota). Identifiers: Dormant season (Crops), Farming.

Soil water recharge during the dormant period was measured for several crops at 17 locations in western Minnosota and eastern South Dakota during a 3-yr period. The experimental areas were on prairie soils developed on calcareous glacial till or on loess overlying till. Annual precipitation is 21-25 inches, of which 10-12 are available for recharge. Soil watercontent at the beginning of the dormant period is a major factor in determining dormant season recharge. The greatest increase in total soil water generally was in late March and early April when precipitation was rain and wet snow and the soil was thawing. Between freeze and thaw, 49% of precipitation was retained by the soil. Spring recharge was 29% of precipitation, and was lowest where initial soil moisture was highest. (K-napp-USGS) W69-02284

STRUCTURAL ALTERATION OF SOIL SUR-FACES BY TILLAGE AND RAINFALL, Agricultural Research Service, Morris, Minnesota. For primary bibliographic entry see Field 03F. For abstract, see . W69-02377

DETERMINATION OF HYDRAULIC CONDUC-TIVITY AS A FUNCTION OF DEPTH AND WATER CONTENT FOR SOIL IN SITU,

CSIRO, Canberra, Div. Land Res. and Reg. Surv., and Australian Nat. Univ. School of General Studies, Dept. of Math.

C. W. Rose, W. R. Stern, and J. E. Drummond. Australian J Soil Res, Vol 3, No 1, pp 1-9, July 1965. 9 p, 4 fig, 19 ref.

Descriptors: *Hydraulic conductivity, *Moisture content, Radiation, *Saturated soils, *Soil profiles, Depth, Soil moisture, Soil water movement, Overburden, Measurement, Hysteresis, Equations, Temperature.

Identifiers: In situ soil, Unsaturated soils, Suction, Vapor.

The paper shows how hydraulic conductivity may be determined in the field over the entire range of water contents on a soil of non-uniform profile. A theory is presented to calculate hydraulic conductivity as a function of depth and successive measurements of water content profiles for soils in situ. With unsaturated soil, potential gradients are inferred using moisture characteristics. With saturated soil potential gradients must be measured directly. Correction due to the overburden effect should be checked whenever in situ soil water suction is inferred from water content via soil moisture characteristics. A possible limitation to the method, particularly if radiation is intense such as in arid climate, might be the effect of daily temperature waves on water redistribution in either liquid or vapor phase. This effect will usually be restricted to the top 20 cm. of the soil profile. Blecker-Ariz) W69-02380

WATER MOVEMENT ABOVE SHALLOW WATER TABLES IN SOUTHERN ALBERTA, Canada Department of Agric., Lethbridge, Alberta, Research Station.

J. C. Van Schaik, and D. S. Stevenson. J Hydrol - Amsterdam, Vol 5, No 2, pp 179-186, 1967. 8 pp, 1 fig, 2 tab.

Descriptors: *Water table, *Soil surfaces, *Evaporation, *Saline soils, Soil moisture, *Soil water movement, Groundwater, Arid lands, Rainfall, Precipitation intensity, Lysimeters, Soil temperature, Water loss, Siphons, Clay loam, Water balance, Seasonal. Identifiers: *Salt accumulation, Alberta (Canada).

Water movement was measured under bare soil with a shallow water table (3-5 feet from the surface) in southern Alberta. Where rainfall from June 1 to November totaled 15 cm. or more, a net downward movement of water could be expected under bare clay loam if the water table was at a depth greater than 1 meter. A net annual upward movement could be expected when the water table is at a depth of less than 1 meter. Under these circumstances water migration during the winter and subsequent evaporation in the spring could add to the salt accumulation at the soil surface. Results indicated that the low evaporation from the water supplied by the groundwater explained the lack of salt accumulation at the soil surface at the study site. The soil and climate conditions that were studied are common in the arid parts of the world. (Blecker-Ariz) W69-02381

ADSORPTION OF SODIUM FROM IRRIGA-TION WATER BY FOUR TEXAS SOILS. Texas A and M Univ., College Station. Grant W. Thomas, and Bruno Yaron. Soil Sci. Vol 106, No 3, pp 213-219. September

1968. 7 p, 4 tab, 6 fig.

Descriptors: *Sodium, Alkaline water, *adsorption, Saline water, *Soil chemistry, Leaching, Electrolytes, Chromatography, Equilibrium, Mineralogy, *Irrigation water, *Cation exchange, Clay gy, *Irrigation water, *Cation exchange, Clay minerals, Flow rates, Texas, Hydraulic conductivi-

Field 02—WATER CYCLE

Group 2G-Water in Soils

Identifiers: *Soil columns.

The adsorption of sodium from saline water during flow through chromatographic columns was stu died utilizing four soil types from Texas having different soil mineralogy texture and cation exchange capacity. Eight synthetic and two natural well waters were used to leach the soils. It was concluded that the relationship between SAR and ESP of soil did not give a significant correlation when sodium containing water flowed through soil columns. The exception was the surace of the soil. The total electrolyte concentration of the sodic water influenced the rate of sodium adsorption. At equilibrium soil mineralogy and the cationic com-position exerted a greater influence over the exchangeable sodium percentages. Mica and montmorillonitic soils had a greater affinity for Na than did montmorillonitic soils. Flow of water in field conditions from equilibrium hydraulic conductivity could not be determined. (Affleck-Ariz) W69-02390

2H. Lakes

RELATIVE RIPARIAN OR LITTORAL RIGHTS RESPECTING THE REMOVAL OF WATER FROM A NATURAL, PRIVATE, NON-NAVIGA-BLE LAKE.

For primary bibliographic entry see Field 06E. For abstract, see W69-02008

OBRECHT V NATIONAL GYPSUM CO (RIPARIAN RIGHTS IN GREAT LAKES). For primary bibliographic entry see Field 06E. For abstract, see W69-02019

VILLAGE OF CHESTER V KANTOD PARK AS-SOC, INC (WITHDRAWAL OF WATER FROM LAKE).

For primary bibliographic entry see Field 06E. For abstract, see .

QUALITY OF WATER AND STRATIFICATION OF POSSUM KINGDOM, WHITNEY, HUBBARD CREEK, PROCTOR AND BELTON RESER-

Texas Water Development Board, Austin. Donald K. Leifeste, and Barney Popkin. Tex Water Develop Board Rep 85, 116 p, Oct 1968. I 6 fig, 5 tab, 18 ref.

Descriptors: *Chemical stratification, *Density stratification, *Reservoirs, *Texas, Limnology, Chlorides, Dissolved solids, Water quality, Water temperature Identifiers: Brazos River Basin (Texas).

The chemical quality and stratification of Possum Kingdom, Whitney, Hubbard Creek, Proctor, and Belton Reservoirs, Texas, were studied between Sept 1961 and May 1965. The water in Possum Kingdom Reservoir generally contains between 1,050 and 1,600 ppm dissolved solids. Inflow varies considerably in salinity and is seldom similar to the water in storage. The low-flow of winter brings highly-saline water to the reservoir; the higher flows of spring usually are of much better quality. The reservoir is seasonally thermally stratified and because salinity is seasonally variable with highest values at winter low flow, the chemical stratifica-tion parallels the seasonal thermal stratification. The water in Whitney Reservoir generally contains 650 and 1,200 ppm dissolved solids. About 2/3 of the inflow is water released from Possum Kingdom Reservoir. Seasonal stratification patterns usually develop only during the winter months when local runoff is small and inflow consists mostly of releases from Possum Kingdom Reservoir. The water quality in Hubbard Creek, Proctor, and Belton reservoirs is good; generally total dissolved solids are below 500 ppm. Stratification occurs only with storm runoff in Hubbard Creek Reservoir and is usually of short duration. (Knapp-USGS) W69-02339

CHLOROPHYLL DERIVATIVES IN SURFACE MUDS FROM THE ENGLISH LAKES,

Toronto Univ., Ontario, Canada, Dept. of Botany. Eville Gorham

Limnol Oceanogr, Vol 5, pp 29-33, 1960. 5 p, 2 fig, 2 tab, 7 ref.

Descriptors: *Plant pigments, *Sediment-water in-*Eutrophication, *Diagenesis, terfaces, Chlorophyll, Mud, Diatoms, Sedimentation, Nutrients, Oligotrophy, Limnology, Lakes, Potash, Carbon, Carbon cycle, Lime, Phytoplankton, Water pollution effects, Water pollution sources,

Spectrophotometry.
Identifiers: *Chlorophyll derivatives, Pheophytin,
Melosira, English Lake District, England, Wastwater, Ennerdale Water, Windermere North Basin,

Esthwaite Water, Priest Pot.

Chlorophyll derivatives, total carbon, and total sulfur were estimated in surface muds from five widely differing bodies of water of the English Lake District (Wastwater, Ennerdale Water, Windermere North Basin, Esthwaite Water, Priest Pot). All three components increased in the muds of these lakes, which varied from large infertile types, low in phytoplankton and poor in lime and potash, to smaller lakes with large phytoplankton crops and more plentiful lime and potash. Carbon, expressed as percentage dry weight of mud, varied from 6.6 (Ennerdale Water) to 18.9 (Priest Pot); sulfur, similarly expressed, from 0.18 (Wastwater) to 1.22 (Priest Pot). Chlorophyll derivatives, in arbitrary units per gram of dry weight, varied between 0.21 (Wastwater) and 6.88 (Priest Pot). Ratios at particular wavelengths (410/350 millimicrons) of optical densities of acetone extracts of mud may be related to balance between autochthonous and al-lochthonous organic matter and to length of time they spend in an oxidizing atmosphere. That ratio for Wastwater (0.7) indicates that chlorophyll derivatives from terrestrial sources may be more important there than in Priest Pot (1.8). Author suggests that concentration of chlorophyll derivatives in mud may be more sensitive as an indicator of lake fertility than concentration of carbon or sul-W69-02369

PHOSPHORUS UTILIZATION ASTERIONELLA FORMOSA,

Ferry House, Far Sawrey, Ambleside, Westmor-Felly Hotac, 1 tal land, England. F. J. Mackereth. J Exp Botany, Vol 4, No 12, pp 296-313, Sept 1953, 18 p, 9 fig, 6 tab, 20 ref.

Descriptors: *Diatoms, *Phosphorus compounds, *Water pollution effects, *Plant growth, Lakes, Growth rates, Population, Productivity, Algae, Cultures, Environmental effects, Nutrients, Cycling nutrients, Essential nutrients, Eutrophication, Nutrient requirements, Phytoplankton.

Identifiers: Lake Windermere, Asterionella, En-

Studies, in Lake Windermere (England), of the relationship of growth of the diatom Asterionella formosa to concentrations of dissolved phosphate occurring there and studies of phosphorus requirements for growth by that organism in culture indicate that it can take up and store reserve phosphorus from concentrations (below 1 microgram per liter) found in phosphorus-poor lakes. Population growth of diatoms continues in phosphorus-deficient media at the expense of cellular phosphorus. Limiting requirements of phosphorus per cell are minute (about 0.06 microgram per million cells). Culture experiments indicate that initial concentrations as low as 1.0 micrograms phosphorus per liter theoretically can produce some 16 million cells per liter. Growth of this diatom in nature conforms to that in culture. Author concludes that very low initial concentrations of dissolved phosphate in Windermere probably do not limit population growth of Asterionella. Cells of this species, low in phosphorus, rapidly take up added phosphorus from lake water but not from distilled water. The unknown factor in lake water, which influences phosphate uptake by depleted cells, appears to be heat labile and dependent upon pH. W69-02371

2I. Water in Plants

THE INTERCEPTION-TRANSPIRATION RELA-TIONSHIP OF WHITE SPRUCE AND WHITE PINE,

Minn. Univ., St. Paul, School of Forestry, and Ariz. Univ., Tucson, Dept. of Watershed Management. J. A. Nicolson, D. B. Thorud, and E. I. Sucoff. J Soil and Water Conservation, V 23, No 5, pp 181-184, Sept-Oct 1968. 4 p, 1 fig, 3 tab, 10 ref.

Descriptors: *Interception, *White pine trees, *Laboratory tests, *Evapotranspiration, Transpiration, Evaporation, Energy budget. Identifiers: White spruce trees

Interception was studied by planting 8 white spruce and 8 white pine trees, all about 3 ft high, about 6 ft apart in pots in a 200 by 600 ft clearing in a forest of oak trees. Relative humidity, air temperature, net radiation, evaporation, and wind velocity were measured. The trees were weighed dry to determine transpiration and weighed after wetting to mine transpiration and weighed after wetting to determine interception. A relationship was determined between transpiration of the wetted trees and the control or unwetted group. Wetted white spruce transpired 53 gm or 17% less than unwetted trees. This was only 13% of the 405 gm of intercepted water, 87% of the intercepted water water transpiration. For evaporated without affecting transpiration. For wetted white pine, transpiration was 42 gm or 14% less than for unwetted trees. This was 12% of the 371 gm of intercepted water. The percentage water saved in white pine decreased as the number of wettings increased. There was no such trend in white spruce. The experimental data are tabulated. (Knapp-USGS) W69-02289

COMPARISON OF WATER POTENTIALS IN LEAVES AS MEASURED BY TWO TYPES OF THERMOCOUPLE PSYCHROMETER, CSIRO, Griffith, N.S.W., Australia, Irrigation

Research Laboratory.

H. D. Barrs.

Australian J Biol Sci, Vol 18, No 1, pp 36-52, February 1965. 17 pp, 10 fig, 2 tab.

Descriptors: *Instrumentation, *Leaves. *Hygrometry, Heat, *Vapor pressure, Respiration, Anaerobic conditions, Aerobic conditions, Cooling, Calibrations, Temperature, Oxygen, *Plant tissues, Plant physiology, Metabolism, Measurement, Moisture stress.

Identifiers: *Thermocouple psychrometer, *Water potential, Dry bulb temperature, Wet bulb temperature.

Two types of thermocouple psychrometers were compared with respect to the measuring of water potentials in leaves. Significant differences were observed between the Spanner and the Richards and Ogata psychrometers. Differences were caused by liberation of heat accompanying aerobic respiration by the tissue which raised the chamber temperature above that of the controlled waterbath in which the chamber was immersed. The two psychrometers agreed closely owing to prevention of temperature rise within the vapor pressure equilibration chambers that contained leaf material. This was done by attaching the leaf to a heat sink in the chamber. The Spanner psychrometer was found to be preferable to that of Richards when working with plant material since it takes into account the departure of chamber temperature from bath temperature caused by metabolic activity, whereas a single Richards psychrometer could not. The thermocouple psychrometer could be used in arid climates to measure water potentials in leaves and to indicate moisture stress in plants. (Blecker-Ariz) W69-02375

AN APPARATUS FOR MEASURING WATER POTENTIALS IN THE XYLEM OF INTACT PLANTS.

CSIRO, Griffith, N S W, Australia, Irrig. Res. Lab. For primary bibliographic entry see Field 03F. For abstract, see . W69.02378

CONTROL OF LEAF STOMATA--THEIR ROLE IN TRANSPIRATION AND PHOTOSYNTHESIS, Israel Zelitch.

American Scientist, Vol 55, No 4, pp 472-486, 1967. 15 pp, 3 fig, 5 tab, 35 ref.

Descriptors: *Stomata, *Transpiration control, Photosynthesis, *Water vapor, *Water conservation, Hydrologic cycle, Leaves, Biochemistry, Diffusion, Plant physiology, Carbon dioxide.

Experiments concerned with the mechanism of stomatal opening and closing were described and the consequences of the biochemical control of stomatal opening on the processes of photosynthesis and transpiration were discussed. Water vapor escaping from the leaf has a shorter path length of diffusion since intercellular spaces within the leaf at the evaporating surface of the mesophyll cells are already saturated with water vapor. Narrowing of stomata in isolated leaves or plants in the laboratory decreases transpiration. Stomatal diffusive resistance is a significant factor in water conservation and control of their width may provide a strategic and rational means of achieving changes of scope in the hydrologic cycle in arid climates. (Blecker-Ariz) W69-02379

RESISTANCE TO GAS FLOW THROUGH THE LEAF AND ITS SIGNIFICANCE TO MEASURE-MENTS MADE WITH VISCOUS FLOW AND DIFFUSION POROMETERS,

Hebrew Univ of Jerusalem, Dept. of Botany. J. Gale, and Alexandra Poljakoff-Mayber. Israel J Bot, Vol 16, No 4, pp 205-211, 1967. 7 p, 2

Descriptors: *Resistance, *Gases, *Flow measurement, *Leaves, Measurement, Viscous flow, Pores, Diffusion, *Water vapor, Vapor pressure, Stomata, Boundary layers, Surfaces.

Identifiers: Gas flow, *Porometers, Vapor exchange, Air vapor, Air vapor density gradient.

Resistance to viscous flow of air through the leaf and resistance to diffusion of water vapor out of the two leaf surfaces were measured simultaneously while environmental conditions were varied in bean and maize leaves. The leaves were subjected to increasing degrees of leaf to air vapour deficit while still attached to well watered plants. The result of this treatment was an increase in resistance to viscous flow which was not paralleled by an increase in diffusion resistance for both species. It was concluded that porometers based on the passage of gas through the leaf may give highly erroneous estimates of leaf resistances to gas and vapour exchange. (Affleck-Ariz)

THE MECHANISM OF SALT TOLERANCE IN SUAEDA FRUTICOSA AND HALOXYLON RECURVUM,

Karachi Univ, Karachi, West Pakistan, Botany Dept.

For primary bibliographic entry see Field 03B. For abstract, see . W69-02396

GROWTH AND WATER REQUIREMENTS OF SOME RANGE PLANTS UNDER CONTROLLED CONDITIONS.

Cairo Univ, Cairo, UAR, Desert Institute, Mataria. A. A. Abd El-Rahman, and M. O. El-Monayeri. Plant and Soil, Vol 29, No 1, pp 119-131, Aug 1968. 13 p, 3 fig, 3 tab.

Descriptors: *Range grasses, Osmotic pressure, Moisture availability, *Plant growth, Soil moisture, Soil-water-plant relationships, Xerophytes, Wilting point, *Water requirements, *Transpiration, Deserts, *Drought resistance, Arid lands. Identifiers: Sap, United Arab Republic.

A study of the growth, water requirements and drought resistance of five introduced and five native range plants was conducted at the Ras El-Hikma Range Research Station of the United Arab Republic. Growth aspects, transpiration rate, and sap osmotic pressure were determined at different levels of available soil moisture from permanent wilting to the moisture equivalent. The transpiration intensity of all the studied species was low and comparable with that of xerophytes living under extremely dry conditions. Most vigorous vegetative growth and highest dry matter production were shown by Chloris gayana. It was concluded that Chloris gayana was the most suitable species for cultivation in desert regions. (Affleck-Ariz) W69-02398

2J. Erosion and Sedimentation

WYATT V WYCOUGH (ACCRETION). For primary bibliographic entry see Field 06E. For abstract, see . W69-02024

STATISTICAL DESCRIPTIONS OF SAND WAVES FROM STREAMBED PROFILES, U. S. Geological Survey, Ft. Collins, Colo., Water Resources Div. Carl F. Nordin, and Everett V. Richardson. Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 25-32, Sept 1968. 8 p, 10 fig, 1 tab, 7 ref.

Descriptors: *Alluvial channels, *Dunes, *Sand waves, *Channel morphology, *Statistical methods, Mathematical models, Methodology, Streambeds, Sediments, Sounding. Identifiers: Gaussian distributions, Streambed profiles.

Statistical treatment of profiles obtained by sonic sounding of dunes in alluvial channels show that bed elevation has approximately a Gaussian distribution, and the amplitudes of the dunes are distributed exponentially. The standard deviation of the bed elevation correlates well with the average amplitude. The mean rest period of a particle can be determined empirically and can be estimated from theoretical considerations of simple models of the dune-forming process. (Knapp-USGS) W69-02343

2K. Chemical Processes

MOLYBDENUM AS A FACTOR LIMITING PRIMARY PRODUCTIVITY IN CASTLE LAKE, CALIFORNIA,

California Univ., Davis, Dept. of Zoology. Charles R. Goldman.

Science, Vol 132, p 1017, 1960. 2 p, 1 fig, 9 ref.

Descriptors: *Molybdenum, *Primary productivity, *Bioassay, California, Carbon radioisotopes, Photosynthesis, Nitrogen fixation, Trace elements, Lakes, Chlovella, Scenedesmus, Cirques. Identifiers: *Castle Lake (Calif.), Alder trees, Al-

Enrichment with molybdic acid or sodium molybdate of waters of Castle Lake, California, a cirque lake with restricted watershed, stimulates the rate of carbon-14 uptake by resident populations of phytoplankton both in situ and in the laboratory. Addition of molybdenum in optimum concentrations of 0.025 ppm showed qualitatively similar tions of 0.025 ppin shower quantatives, summeresults throughout the year. In a typical experiment, addition of 0.10 ppm molybdenum resulted in uptake of carbon-14 (expressed as counts per minute) approximately three times greater than in unenriched controls after four days incubation. Author suggests that trace element deficiencies may be characteristic of lakes with limited watersheds. He also suggests that the effect of molybdenum deficiency in this lake is mediated via nitrogen reductase in the nitrogen fixation-reduction system and that heavy growth along the shores of alder--a nitrogen-fixing species--competes with the lake for available molybdenum. W69-02373

2L. Estuaries

TIDEWATER TITLES CONFIRMED.

Ga Code Ann Sec 2-601 (1967).

Descriptors: *Georgia, Legislation, *Ownership of beds, *Low water mark, *Tidal waters, State jurisdiction.

Identifiers: Constitutional provisions.

The Georgia Constitution, by this provision, ratifies the 1902 Act of the General Assembly which extends the title of ownership of lands abutting on tidal water to the low water mark. (Williams-Fla) W69-02061

THE EFFECT OF FRESH-WATER RUN-OFF ON A POPULATION OF ESTUARINE POLYCHAETOUS ANNELIDS, For primary bibliographic entry see Field 05C.

For abstract, see . W69-02215

ON THE CHANGE IN SALINITY DISTRIBUTION AND BOTTOM TOPOGRAPHY AFTER THE CLOSING OF THE MOUTH OF KOJIMA BAY,

Kyoto Univ., Kyoto, Japan, Disaster Prevention Research Institute. Setsuo Okuda.

Bull of Disaster Prev, Res Inst, Vol 18, Part 1, No 133, pp 35-48, July 1968. 14 p, 9 fig, 2 tab, 5 ref.

Descriptors: *Estuaries, *Reservoirs, *Salinity, *Saline water-freshwater interfaces, *Salt balance, Topography, Saline water intrusion, Winds, Mixing

Identifiers: Polders (Japan).

The effects of closing of Kojima Bay, an estuary in southern Okayama Prefecture, Japan, to make a fresh-water reservoir, were studied. The salinity distribution, flow pattern, and topography of the bottom were changed. In the rivers entering the reservoir, salinity increase is approximately linear downstream. In the lake, there is a stable horizontal interface between inflowing river water and lower salt water. The position of the interface varies with riverflow, irrigation pumping, and intrusion of sea water when the gates are open. The change with gate opening averages 20-40 cm. Winds cause mixing which blurs the interface and strong drift currents which tilt it. The salt balance effect of river inflow and outflow, polder drainage, and seawater intrusion was calculated and the results are tabulated. (Knapp-USGS)

COOPER RIVER, SOUTH CAROLINA (SHOALING IN CHARLESTON HARBOR). Corps. of Engineers, Washington, D. C.

Field 02—WATER CYCLE

Group 2L—Estuaries

U S 90th Congr, 2d Sess, Senate Doc No 88, 206 p, 1968. 3 fig, 5 plate, 5 tab, 1 suppl, 1 append.

Descriptors: *Harbors, *Sedimentation, *Density currents, Salinity, Canals, Model studies, Hydroelectric power, South Carolina. Identifiers: Santee River, Cooper River, Charleston Harbor.

Study of the shoaling of Charleston Harbor, South Carolina, showed that shoaling increased soon after diversion of water by a hydroelectric power project from the Santee River into Cooper River and Charleston Harbor in 1942. The investigation, which included model tests, proved that the diversion caused the shoaling by interaction of increased fresh water discharge with salty harbor water and formation of bottom density currents, predominantly upstream, which prevent settled sediment from being flushed out to sea. The best remedial plan is to redivert the Santee River water back to the Santee River through a canal. A powerplant of 84,000 Kw is proposed for the canal. The existing plant would be operated at a reduced output. Total power would be increased, while discharge to the harbor would be greatly reduced. Cost is estimated to be \$35,381,000. The benefit-cost ratio is estimated to be 2.17 for 50-year amortization, and for 100-year amortization, 2.73. (Knapp-USGS) W69-02296

NUMERICAL STUDIES OF UNSTEADY DISPERSION IN ESTUARIES.

Massachusetts Institute of Technology, Cambridge, and Gibbs and Hill, Inc., Boston, Massachusetts. Donald R. F. Harleman, Chok-Hung Lee, and Lawrence C. Hall.

ASCE Proc, J Sanit Eng Div, Vol 94, No SA 5, Pop 6160, pp 897-911, Oct 1968. 15 p, 11 fig, 9 ref.

Descriptors: *Mathematical models, *Estuaries, *Saline water intrusion, *Tides, Currents (Water), Digital computers, Tracers, Dye releases, Dispersion, Path of pollutants.

Identifiers: Finite-difference methods, Potomac

one-dimensional mathematical model is developed which describes the longitudinal concentration distribution of a pollutant in an estuary. The importance of including the tidal velocity in the advective term of the mass balance equation is emphasized. The cross-sectional area, the tidal and fresh water velocities and the longitudinal dispersion coefficient may all be functions of distance and time. The unsteady equation for the concentration distribution is solved by an implicit, finite-difference technique on a digital computer. The difference in the magnitude of the longitudinal dispersion coefficient, E, in the salinity intrusion region and in the fresh water tidal portion is described. A modification of Taylor's dispersion equation is presented for the determination of E in the fresh water tidal portion of an estuary. The mathematical model is applied to the upper portion of the Potomac estuary and the results are compared with field observations for a 13-day period in which dye was injected into the estuary. The predicted concentration distributions are in reasonable agreement with the measured values. The magnitude of E is of the order of 0.1 sq mile per day. The importance of nonlinear tidal motion effects is described in relation to the distribution of pollutants in estuaries. (Author) W69-02346

DIFFERENCE MODELING OF STREAM POL-LUTION.

Oregon State Univ., Corvallis, and New York Univ., New York.

For primary bibliographic entry see Field 05B. For abstract, see . W69-02367

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

JOINT WATER SUPPLY FACILITIES. For primary bibliographic entry see Field 06E. For abstract, see . W69-02017

WATER SUPPLIES AND SEWAGE DISPOSAL IN BERLIN,

K. Huhnerberg

Gas Wasserfach, Vol 104, pp 1203-1213, 1963.

Descriptors: *Sewage treatment, *Storm runoff, *Overflow, Sedimentation. Identifiers: *Combined sewers, Capacity, Berlin (Germany).

A detailed illustrated description is given of the sources and treatment of water supply and of sewage disposal in the area of West Berlin from the Elbe-Saale to the Oder and Neisse. Increased demands due to industrial development have necessitated extensions and reconstructions of existing water works and construction of new water works and sewage-treatment plants. The performance of the various water works is tabulated. Finally, the author discusses the advantages of combined over separate sewerage systems and the design and dimensions of sedimentation tanks and storm-water overflows.

ON THE CHANGE IN SALINITY DISTRIBUTION AND BOTTOM TOPOGRAPHY AFTER THE CLOSING OF THE MOUTH OF KOJIMA BAY,

Kyoto Univ., Kyoto, Japan, Disaster Prevention Research Institute.

For primary bibliographic entry see Field 02L. For abstract, see . W69-02290

TRENDS IN RESERVOIR CAPACITY AND USE, U. S. Geological Survey, Washington, D. C. W. B. Langbein.

Ind Water Eng, Vol 5, No 10, pp 30-31, Oct 1968. 2 p, 2 fig.

Descriptors: *Reservoirs, *Water users, Multiplepurpose reservoirs, Conservation, Dams, Irrigation water, Recreation, Municipal water, Industrial water, Hydroelectric power, Flood control. Identifiers: Reservoir capacity, Water-use study.

The recent history of dam and reservoir construction and use in the U S is reviewed. There are over 1,600 reservoirs larger than 5,000 acre-ft. The growth in total reservoir capacity has been a steady 80% per decade since 1900, contrasting with a 40% increase in total water use and a 20% population growth. There have been significant changes in reservoir use. In 1900, most reservoirs were for municipal supply and power generation purposes. With passage of Federal Reclamation laws in 1902, irrigation storage increased and became the largest component of reservoir capacity in the 1920's. The flood control acts of 1936 and 1938 expanded that use until now it exceeds irrigation. The present rank is power first, flood control second, irrigation third and water supply fourth. Since the 1930's, there has been great emphasis on multiple-use reservoir size, from 60,000 acre-ft before 1933 to 370,000 acre-ft after 1950. The trend toward larger reservoirs probably will decline as most large sites are used, but reservoirs will remain an important part of American water management. (Knapp-USGS) W69-02336

THE MECHANISM OF SALT TOLERANCE IN SUAEDA FRUTICOSA AND HALOXYLON RECURVUM, Karachi Univ, Karachi, West Pakistan, Botany

Dept.

Rafiq Ahmad. Plant and Soil, Vol 28, No 2, pp 357-362. Apr 1968. 7 p, 2 tab.

Descriptors: *Halophytes, *Plant physiology, Salinity, Saline soils, *Salt tolerance, Alkaline soils, Toxicity, Cytological studies, Cation exchange, Sampling, Soil chemistry, Granules, X-ray spectroscopy, Irrigation effects.

Physiology of salt tolerance in plants has the attention of plant scientists because salinity and alkalinity are taking over large areas of irrigated land all over the world. A study was conducted in West Pakistan using Suaeda fruiticosa and Haloxylon recurvum to determine how the harmful effects of excess salts are offset within the plant. Free hand sections of their leaf and stem revealed the presence of intracellular granular structures in various regions of the hypodermis, cortex and pith. On analysis they were found to contain salts of Na, K, Ca, and Mg impregnated with some quartz particle which rendered them insoluble to water. It was concluded that the cells worked merely as storehouses and did not let the mineral interfere in the normal metabolism of the plant. This was considered as one of the adoptive mechanisms for inducing salt tolerance in the halophytes. (Affleck-Ariz) W69-02396

3C. Use of Water of Impaired Quality

WASTEWATER REUSE AT THE GRAND CANYON.

Arizona State Department of Health, Phoenix. For primary bibliographic entry see Field 05D. For abstract, see . W69-02349

REMOTE SENSING FOR ESTIMATING SOIL SALINITY.

Agricultural Research Service, Soil and Water Conservation Research Div. For primary bibliographic entry see Field 07B. For abstract, see .
W60-07385

EFFECT OF SOIL SALINITY ON EXTERNAL MORPHOLOGY OF COTTON LEAVES, Agricultural Research Service, Weslaco, Texas.

Harold W. Gausman, and Ruben Cardenas. Agron J, Vol 60, No 5, pp 566-567, Sept-Oct 1968. 2 p, 3 tab.

Descriptors: *Saline soils, *Plant morphology, *Leaves, Epidermis, Cytological studies, *Cotton, Plant growth, Plant physiology, *Remote sensing, Sampling, Stomata, Texas, Microscopy, Loam. Identifiers: Leaf thickness, Rio Grande Valley, Photomicroscopy.

A study on the external morphology of leaves from cotton grown in areas of low and high soil salinity was conducted at Weslaco, Texas, in the Rio Grande Valley. The fourth leaf from the apex of each cotton plant was sampled and the thickness of each leaf was measured. Also counts on the number of stomata and epidermal cells, and measurements on their size were made. Microscopic examination revealed that high salinity caused fewer epidermal cells and stomata per unit area, increased surface size of epidermal cells, and increased leaf thickness. (Affleck-Ariz) W69-02392

SODIUM HAZARD OF IRRIGATION WATERS AS INFLUENCED BY LEACHING FRACTION

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 03

Conservation in Agriculture—Group 3F

AND BY PRECIPITATION OR SOLUTION OF CALCIUM CARBONATE,

Salinity Laboratory, Riverside, Calif. C. A. Bower, G. Ogata, and J. M. Tucker. Soil Sci, Vol 106, No 1, pp 29-34, July 1968. 6 p, 4 fig, 5 tab.

Descriptors: *Sodium, *Irrigation water, *Leaching, *Chemical precipitation, *Calcium carbonate, Hydrogen ion concentration, Lysimeters, Alfalfa, Salinity, Loam, Adsorption, Cation exchange, Drainage water, Calcium, Magnesium. Identifiers: Leaching fraction, Steady state values.

Calcareous Pachappa sandy loam in lysimeters growing alfalfa was irrigated with six waters having variable Na/ (Ca + Mg) and HCO3/ (Cl = SO4) ratios at leaching fractions of .1, .2, .3, and .4, until the sodium adsorption ratio of the drainage water became constant. Increased leaching repressed precipitation of CaCO3 from the waters and enhanced solution of CaCO3 from the soil. At any leaching fraction the amount and fraction of applied HCO3 that precipitated as CaCO3 from the water or the amount of CaCO3 that dissolved from the soil was highly related to a calculated pH value of the water which was dependent primarily upon the Ca, Mg, and HCO3 concentrations of the the Ca, Mg, and HCO3 concentrations of the water. When the sodium-adsorption ratio of the drainage waters from the lysimeters had become constant, the salt and exchangeable Na that had accumulated in the soil increased with depth. (Af-W69-02393

EFFECT OF SALINITY AND WATER SUPPLY ON OLIVE, Cairo Univ, Cairo, UAR, Dept of Botany.

A. A. Abd El-Rahman, and M. H. Sharkawi Plant and Soil, Vol 28, No 2, pp 280-290, Apr 1968. 11 p, 6 fig.

Descriptors: *Salinity, *Osmotic pressure, *Salt tolerance, Soil moisture, Soil-water-plant relationships, Absorption, Plant growth, *Transpiration, Arid lands, *Irrigation water, Wilting point, Deserts, On-site investigations, Leaves, Moisture availability, Groundwater. Identifiers: Olive trees, Sap, Egypt.

An investigation was conducted at Burg El Arab, Egypt, aimed at extending the areas of the desert planted with olive as much as possible with the limited amount of water available in the desert region and to make use of saline underground water. Therefore a study was conducted to find out the highest salinity of the underground water that could be tolerated by the young developing plants and how much salinity controls water uptake. Also the effects of water supply were studied to deter-mine the lowest moisture level required for the growth of the young plants, and to avoid the use of excess water. Young olive plants failed to grow when irrigated with water having an osmotic pressure of 25 atm. or higher. The successful growth of young plants irrigated with water having an osmotic pressure of 15 and 20 atm. indicated that young olive plants could be irrigated with underground water whatever its salinity provided that subsurface irrigation was applied to avoid capillary rise and ac-cumulation of salts on the surface. (Affleck-Ariz) W69-02397

3D. Conservation in Domestic and Municipal Use

METROPOLITAN WATER SUPPLY AND UTILIZATION.

Mass Ann Laws, Ch 92, Secs 16-19 (1966).

Descriptors: *Massachusetts, *Cities, *Water utilization, *Water supply, Legislation, Domestic water, Water districts, Water rates, Adjudication procedure, Environmental sanitation, Diversion, Administrative agencies, Regulation, Judicial deci-

sions, Compensation, Fishing, Fouling, Wastewater (Pollution), Public utilities. Identifiers: Abandoned waters.

Section 16 provides that no town, except Hingham and Hull, within ten miles of the state house, nor any water company in such town, shall, except in case of emergency, use for domestic purposes water from any source not now used by it except as provided in Chapter 92. Compensation for the taking of any water company in such town shall not be affected by Chapter 92. The section provides the procedure before the Supreme Judicial Court for setting water rates for Hingham and Hull. Section 17 empowers the Department of Public Health to make rules and regulations for the sanitary protection of such waters. The rules must be posted and published in a newspaper to give sufficient notice. The certificate of any member of the commission of such posting and publication shall be prima facie evidence thereof. Any of such waters abandoned as a water supply shall be open for fishing purposes. Section 18 is a general prohibition against diversion, pollution, and waste of the water supply of any town in the metropolitan water district. Section 19 specifies the classes of persons to which Section 18 is not applicable. (Smodish-Fla) W69-02031

NATIONAL PLAN TO SUPPLY DRINKING WATER TO URBAN DISTRICTS, 1966-1970. (SPANISH).

Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 214-232, 1968. 19 p, 5 tab, 12 photo, 1 fig, 1 chart, append.

Descriptors: *Potable water, *Water distribution (Applied), *Urban sociology, Water resources development, Capital costs, Priorities, Water policy, Project purposes, Urbanization. Identifiers: *Mexico, *National water-supply plan,

Water management plan, Urban planning

A National Plan to Supply Drinking Water to urban districts in Mexico is described as it was presented before the 7th National Congress of Civil Engineers, Guadalajara, in November 1967. The plan is an integral part of the national investment policy and calls for specific action on the part of private enterprise in cooperation with the Federal Government. Ultimate objective is auto-sufficiency for the water systems, both economically and administra-tively. The goal set is to enlarge and improve existing systems and initiate required new works. Priority will be given to cities that offer greater expansion possibilities, such as State capitals, seaports, tourist towns, and industrial centers. The intention is to benefit the 1,500 urban districts that are widely distributed and would serve 70% of the urban people by 1970. Only 48% had adequate water facilities in 1966. The plan calls for an investment totaling 2,000 million pesos. Administrative and legal aspects of the plan are carefully analyzed. (Lang-USGS) W69-02366

3F. Conservation in Agriculture

SOUTH SASKATCHEWAN RIVER PROJECT, I. B. Mackintosh. Water Power, Vol 15, No 9, pp 361-8, Sept 1963,

pp 403-8, Oct 1963.

Descriptors: *Tunnel construction. Identifiers: *Mole tunneling, Canada.

Project between Government of Canada and Province of Saskatchewan is featured that is aimed to irrigate 500,000 acres in area affected by droughts, develop hydroelectric power, provide urban water supply, give flood control and provide recreational facilities; earthmoving operations on 8000 ft long 64 million cu yd dam are described in province in the propagate operation and conjunction with embankment construction and construction of power intake shafts; use of 'Mole' tunnel boring machine for tunneling through shale. W69-02076

IRRIGATION IN KANSAS.

Kansas Water Resources Board, Topeka. For primary bibliographic entry see Field 06D. For abstract, see . W69-02348

HUMIDITY SENSOR: PERMANENT ELECTRIC HYGROMETER FOR CONTINUOUS MEASUREMENT OF THE RELATIVE HUMIDITY OF THE AIR,

Michigan State Univ., East Lansing. For primary bibliographic entry see Field 07B. For abstract, see . W69-02374

STRUCTURAL ALTERATION OF SOIL SUR-FACES BY TILLAGE AND RAINFALL,
Agricultural Research Service, Morris, Minnesota. R. E. Burwell, R. R. Allmaras, and L. L. Sloneker.

J Soil and Water Cons, Vol 21, No 2, pp 61-63, March-April 1966. 3 pp, 2 fig, 2 tab.

Descriptors: Soil management, *Soil surfaces, *Infiltration, *Runoff, Water conservation, Erosion control, *Porosity, *Rainfall, Cultivation, Slopes, Soil structure, Loam, Pores, Rainfall-runoff relationships, Soil texture, Soil moisture, Moisture con-

Identifiers: Roughness.

The article discussed interrelation of rainfall with various tillage methods and advantages of each combination as a means of conserving water and combating erosion. Tillage methods used in the study were: untilled, plow, plow-disk-harrow, cultivated and rotovated. Rainfall was artificially applied to loam soil at the rate of 5 inches per hour to each of the freshly tilled surfaces. Rainfall decreased random roughness and total pore space of freshly tilled soil. Most of the decrease occurred during the period before initial runoff. Pore space modified the effectiveness of random roughness for delaying initial runoff. A large pore space alone did not delay initial runoff. A large initial runoff was modified by tillage practices. Cumulative infiltrations were significantly affected by all tillage treatments, but only in the case of rough surfaces was infiltration prior to initial runoff significantly greater than the cumulative infiltration which occurred following initial runoff. (Blecker-Ariz) W69-02377

AN APPARATUS FOR MEASURING WATER POTENTIALS IN THE XYLEM OF INTACT

PCLANTS, CSIRO, Griffith, N S W, Australia, Irrig. Res. Lab. A. R. G. Lang, and H. D. Barrs. Australian J Biol Sci, Vol 18, No 3, pp 487-497, June 1965. 1 pp, 5 fig, 4 tab.

Descriptors: Plant physiology, Hygrometry, *X-ylem, *Temperature, Water vapor, *Vapor pressure, Moisture uptake, Instrumentation, Leaves, *Measurement, Energy budget, Calibrations,

Equilibrium. Identifiers: Thermocouple psychrometer, *Water potential, *Intact plants, Stem.

This paper described a new method and apparatus for estimating water potentials in the xylem of a plant. The method is based on the fact that energy of water in the vapor phase in equilibrium with the attached leaf gives a measure of the energy of water in the conducting elements of the stem xylem. Constant temperature of the leaf-vapor system was a critical requirement for the technique. The apparatus was based on the thermocouple Illustrative experiments psychrometer. described in which continuous records of the estimated water potential in the xylem of cotton and pepper plants were given for periods of up to 10 hours. The method can, in principle, be applied to all plants in an arid climate which have suitable long petioles and broad leaves. (Blecker-Ariz) W69-02378

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation in Agriculture

ARIDITY DEFINITIONS AND THEIR APPLICA-

Swedish Meteorological and Hydrological Institute, Stockholm

For primary bibliographic entry see Field 02B. For abstract, see W69-02384

MANAGEMENT: A KEY TO IRRIGATION EF-FICIENCY.

Water Conservation Laboratory, Phoenix, Arizona. For primary bibliographic entry see Field 06D. For abstract, see

THE CLIMATE OF THE COTTON CROP: PHYSICAL CHARACTERISTICS AND AND MICROCLIMATE RELATIONSHIPS,

Volcani Institutue of Agricultural Research, Rehovoth, Israel.

G. Stanhill, and M. Fuchs.

Agricultural Meteorology, Vol 5, No 3, pp 183-202. May 1968. 20 p, 9 fig, 5 tab.

Descriptors: *Cotton, *Climatic data, *Irrigation effects, Humidity, *Microclimatology, Air temperature, Growth stages, Semiarid climates, Energy budget, *Crop response, Vapor pressure, Wind velocity, Albedo, Water loss, Hygrometry, Soil temperature, Anemometers, Solar radiation, Heat. Identifiers: *Aerodynamics, *Energy balance, Israel, Solar elevation, Physical characteristics, Heat storage.

A study of the radiative and aerodynamic characteristics of two irrigated cotton crops was made in a semi-arid zone of Israel. Some of the physical characteristics of the irrigated cotton crop of importance in the modification of the crop microclimate were studied and the relationship between the climate over the crop and that measured at an adjacent open site were determined. Air temperature was always less and humidity greater at the irrigated crop than over the bare soil. Results obtained were compared with those previously reported in the literature for this crop in order to see to what extent they may be considered as being of general application. Microclimate is a factor of great importance in determining yield and water loss from agricultural crops. (Affleck-Ariz) W69-02394

EFFECT OF IRRIGATION TREATMENTS ON ALFALFA (MEDICAGO SATIVA L.) PRODUCTION, PERSISTENCE, AND SOIL SALINITY IN SOUTHERN CALIFORNIA.

Imperial Valley Field Station, El Centro, Calif. and Calif. Univ, Riverside

W. F. Lehman, S. J. Richards, and D. C. Erwin. Hilgardia, Vol 39, No 9, pp 277-295. June 1968. 19 p, 8 fig, 6 tab.

Descriptors: *Alfalfa, *Irrigation effects, *Rates of Descriptors: "Anana, "Irrigation effects, "Rates of application, California, "Crop response, Saline soils, "Salt tolerance, Soil-water-plant relationships, Tensiometers, Arid lands, Sampling, Leaching, Root zone, Diseases, Grasses, Winter,

In the Imperial Valley of Southern California two experiments were conducted to study effects of irrigation management on alfalfa yield, stand persistence, and soil salinity levels in the root zone. Irrigation treatments were based on frequency as determined by tensiometers and on duration of irrigation. In experiment I, where the soil was clay and clay loam, frequent short irrigation or moderate treatment was superior to normal short and frequent long irrigation treatments in yield, stand persistence, and hay quality. In experiment II where the soil was silty clay loam on top of sandy clay, yield was similar for all treatments, but an invasion of grass resulting from weaker stands reduced the quality of the hay produced in the frequent long treatment. Disease incidence was higher in the wet than the dry treatments. Soil

rigation in both experiments. (Affleck-Ariz) W69-02395 salinity was inversely related to hours of applied ir-

04. WATER OUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on **THE Surface**

KISTLER V WATSON (IMPROPER RESTRIC-TION OF STREAM FLOW).

156 A 2d 833-836 (Ct App Ohio 1959).

Descriptors: *Ohio, Civil law, Judicial decisions, Natural flow doctrine, Watercourses, *Dams, Riparian rights, Alteration of flow, Diversion, Reasonable use, Impounded waters, Farm ponds, Flow, Average flow, Natural flow, *Flow rates, Obstruction to flow

A natural watercourse flowed across defendant's property and then across plaintiff's land. This spring ran for over fifty years until defendant constructed a dam to create a pool of water on his property. There was evidence that the stream was dry for the first time after the constuction of the dam. The court held that a riparian owner such as the defendant had a legal right to impound the water to create a pond provided he permited water to reach the land of the lower riparian owner in a substantially normal flow. Finding that the dam had materially affected the continuity of the flow and diminished the amount of water which unimpeded would otherwise have flowed onto plaintiff's land, the court ordered the defendant to restore the flow of water from the spring as it flowed in its natural course without artificial piping or diversion. (Scott-W69-02001

MONTELIOUS V ELSEA (WITHDRAWAL FOR IRRIGATION).

For primary bibliographic entry see Field 06E. For abstract, see W69-02003

BURCH V MACKIE (SURFACE RUNOFF). 362 Mich 488, 107 NW 2d 791 (1961).

Descriptors: Surface water, *Alteration of flow, *Michigan, Legislation, Highways, Drainage, Highway effects, *Road construction, *Surface runoff, Drainage water, Surface drainage, Natural flow, Floods, State governments, Administrative agencies, Ditches, Diversion, Judicial decisions.

In the process of a highway improvement the state highway department caused changes in the drainage arrangement previously existing, which resulted in an unreasonable diversion of surface water damaging plaintiff's land. The road construction work also raised the crown of the highway causing a barrier to the natural flow of surface water. The attorney general of the State, appearing on behalf of defendant, filed a motion to dismiss claiming the highway department was engaged in a governmental function and thus immune from suit and liability, and that plaintiffs' proper remedy is afforded by the statutes relating to the establishment of drains by the county drain commissioner. The trial court dismissed the complaint on the basis that the condition complained of by the plaintiffs, may be remedied by proper proceedings under the Frain Code of 1956. The court here affirmed, but there is a separate concurring opinion based on the concept of governmental immunity, and an extensive dissent. (Smith-Fla)

CERNAK V KAY-VEE REALTY (LIABILITY FOR SURFACE DRAINAGE DISCHARGE). 169 N E 2d 879 (Mass 1960).

Descriptors: *Massachusetts, Watercourses, Negligent inundation, Damages, Value, Civil law, Judicial decisions, Outlets, Alteration of flow, *Drainage system, Controlled drainage, Drainage water. Surface runoff, Discharge, *Surface drainage.

Defendant, a land developer, constructed a surface drainage discharge system on its property that collected water from streets in a development project, and channeled it to a discharge pipe. After leaving this discharge pipe, the water passed through a culvert on land owned by a railroad, and then onto plaintiff's land making it very wet and swampy in spots. A landowner is permitted to improve his land by changes of grade, even if the natural course of the surface water is thereby changed, but he will be held liable for damages caused by discharge of water on the land of another by means of an artificial channel, either directly or by seepage. The fact that there was an intervening landowner between the plaintiff's tract and the defendant's tract cannot alter the defendant's responsibility, nor can the fact that other sources may contribute to the flow. (Scott-Fla) W69-02020

SULLIVAN V BOARD OF COMMISSIONERS OF LORAIN COUNTY (INCREASED SURFACE DRAINAGE FROM UPPER LAND). 172 NE 2d 20 (Ohio Ct App 1960).

Descriptors: Judicial decisions, *Ohio, *Surface runoff, *Ditches, Reasonable use, Rainwater, Sewage effluents, Administrative agencies.

Defendant proposed to enlarge and improve a drainage ditch running from his upper land through plaintiff's lower land, to carry increased surface ru-noff due to improvement of the upper property and to accomodate sewage effluent from a proposed sewage treatment plant. Plaintiff filed suit to enjoin defendant from undertaking to widen and deepen such ditch. The court held that the ditch was a natural watercourse and if the defendant increased the flow by improving his land, there would be no liability unless he commits unreasonable or negligent acts. One who produces sewage must care for it and not permit it to injure his neighbor. However, since the plant was not yet constructed and placing effluent in the ditch, the court refused to act and said that if future injury did occur, that would be the proper time for judicial intervention. Williams-Fla) W69-02021

LOUISVILLE AND NASHVILLE R R V BUSH (DRAINAGE OF SURFACE WATER). 336 SW 2d 578-581 (Ct App Ky 1960).

Descriptors: *Kentucky, Judicial decisions, Surface water, Runoff, *Surface runoff, Overland flow, Drainage, *Flood damage.

Appellant railroad company appealed a trial court decision which held it liable for flood damage resulting from drainage of surface water from its higher land onto appellee's lower land. Appellant installed a new drain pipe through railroad fill on the lower side of its property to replace an old, damaged culvert. This allowed drainage of surface water from the upper land onto appellee's land. The court held that for appellant to be liable for damage to appellee's land from this flow it had to be shown that appellants had done something to increase the surface water flow, either adding drainage from another watershed or by diverting water from natural drains which otherwise would not have flowed through the pipe onto the lower estate. Appellee failed to prove that appellant had done anything to alter the natural surface water drainage. The court reversed. (Sisserson-Fla) W69-02023

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Control of Water on the Surface—Group 4A

LIABILITY FOR OVERFLOW OR ESCAPE OF WATER FROM EXCAVATION MADE IN COURSE OF CONSTRUCTION. 23 A L R 2d 827-830, 4 p, 11 ref.

Descriptors: *Overflow, *Flood damage, Dams, Reservoirs, Percolation, Percolating water, Subsurface runoff, Subsurface waters, Surface runoff, Floods, Repulsion (Legal aspects), Water law, Legal aspects.

The annotation considers the liability of an owner when water escapes from his land to that of an adjoining owner. The article distinguishes between the deliberate impounding of waters; the obstruction of streams; and the impounding of waters in the course of construction operations. The rule of absolute liability is variously applied to each of these situations. The article discusses the rule of absolute liability as it applies to the latter situation only. (Horner-Fla) W69-02030

APPLICATION OF HUIE (LIABILITY FOR DIVERSION)

192 NYS 2d 620 (Sup Ct 1959).

Descriptors: Civil law, *New York, *Easements, *Eminent domain, Judicial decisions, Riparian land, *Diversion, Value, Alteration of flow, Riparian rights, Damages, Worth, Property values, Monetary worth, Relocation, Withdrawal municipal water.

In this proceeding by the Board of Water Supply of City of New York, the court held that persons who were nonriparian owners of land but owned easements permitting them and their guests access to the river were not trespassers in the use of river waters, since by implication, easements include the right to use the water. When the City of New York acquired rights to divert a river for the purpose of acquiring an additional water supply, nonriparian property owners having such easements were awarded damages to compensate them for the decrease in value of their lands caused by the diversion. The measure of damages was the difference between the value of their properties immediately prior to and after the diversion of the river. (Scott-W69-02034

REPAIRS AND CLEANING OF CANALS SEWERS OR AQUEDUCTS; WORKS OBSTRUCTING OR EMBARRASSING PUBLIC PLACES, NAVIGABLE RIVER BEDS OR BANKS.

La Civil Code art 860, 861.

Descriptors: *Louisiana, Civil law, Ownership of beds, Banks, *Public rights, Riparian land, State governments, *Cleaning, *Repairing, Maintenance, Canals, Sewers, Aqueducts, Public benefits, Public health, Safety, Beds, Streambeds,

The cleaning or repairing of canals, spouts, sewers, or aqueducts by owners may not be objected to, because such work benefits the public interest and safety. Works formerly built on public places, or in the beds or on the banks of rivers or navigable streams, that interfere with the use of same, may be destroyed at the expense of those claiming ownership, at the instance of any legally competent resident. (Scott-Fla) W69-02037

JURISDICTION OF COURT WHERE BODY OF WATER IS PARISH BOUNDARY. La Crm Pro Code Ann art 613 (West 1967).

Descriptors: *Louisiana, Legislation, *Jurisdiction, Legal aspects, *Local governments, *Boundaries, Bodies of water. Identifiers: Courts

When a body of water is a parish boundary, the jurisdiction of the court of such parish extends to the middle of such body of water. (Childs-Fla) W69-02038

DUTIES OF CITY ENGINEERS -- POWERS OF POLICE JURIES.

La. RS 1965 33:727 and 1236-1237.

Descriptors: *Louisiana, Civil law, Drainage districts, *Local governments, State governments, Engineering personnel, Drains, Ditches, Canals, Culverts, Streams, Sewers, Water courses (Legal), Dikes, Dams, Levees, Banks, *Navigation, Inland waterways, Transportation, Public health, Seepage, Legislation.

Subject to the supervision and control of the city manager, the city engineer shall manage and have charge of, among other things, the construction, improvement, repair and maintenance of sewers, drains, ditches, culverts, canals, streams, and watercourses. Police juries shall have the power to regulate, among other things, the making and repairing of dikes, dams, and levees; and to regulate the clearing of the banks of rivers and natural drains for the purpose of improving navigation. Police juries may also build dams to prevent the passage or encroachment of salt water into fresh water streams, when such salt water is found to be injurious to property; and may create drainage districts, to control all drainage, drainage ditches, and drainage canals. Police juries may also institute eminent domain proceedings, or purchase or lease lands needed for the construction and improvement of the Inland Water Channel; and may close and dam on its own initiative certain small canals or streams which it finds hazardous or harmful to property or to the public health. (Scott-Fla) W69-02040

LEVEES AND DRAINAGE IN GENERAL. La RS 38:111-225 (1965).

*Louisiana. Drainage districts. *Drainage, Local governments, Right-of-way, State governments, Utilities, Construction, Maintenance, *Levees, Overflow, Mississippi River, Bayous, Navigation, Public rights, Eminent domain, Canals,

Identifiers: Crimes, Criminal offenses.

Any drainage district may contract with the department of public works for drainage and reclamation projects. Local levee authorities shall cooperate with the state and federal governments for construction and maintenance of all levees necessary for protection against overflow of the Mississippi River. The various districts shall control all public drainage channels within the limits of their districts, and for one hundred feet on each side of the channel. When levees cross bayous or sloughs, certain construction methods must be used. Works erected in front of levees shall be destroyed at their owner's expense when they interfere with navigation or the use of the public. Police juries shall have the power to expropriate land or improvements for drainage canals or projects. All levees and parallel or contiguous public roads must be drained. Police juries may also erect back and side levees when needed, as well as temporary levees. Cities and towns have the same general powers as police juries concerning levees. It is a criminal offense to willfully cut or destroy any levee, or to attempt to do so. It is also an offense to ride, drive, or haul upon public levees except where provision is made for same by the levee commissioners; to obstruct drainage by dumping materials into any waters or drains; to drain oil, salt water, or noxious substances into any natural drain or stream; to drain water onto a public road; or to otherwise interfere with or obstruct drainage of any road or channel. (Scott-Fla) W69-02041

REGULATION OF CANALS.

La RS 1965 45:61-67.

Descriptors: *Louisiana, Hydroelectric project licensing, *Right-of-way, *Canals, Irrigation, canals, Navigable waters, Irrigation permits, Public utilities, Hydroelectric power, Hydroelectric plants, Transportation, Transmission lines, Reservoirs, Dikes, Damsites.

Domestic corporations formed for the purpose of constructing and operating canals for irrigation by gravity have the power to obtain rights-of-way by purchase or expropriation, and to use the waters of the state, including navigable streams, for irrigation purposes. Such corporations have the status of public service corporations. Domestic corporations not included above that are organized for the development of hydro-electric power or the transportation of freight or passengers have the power to obtain rights-of-way for these canals and for telephone, telegraph, and hydro-electric lines, as well as lands for reservoirs, damsites, and dikes, by similar methods. Maximum widths for rights-of-way are prescribed. (Scott-Fla) W69-02042

SAINATO V POTTER (DAMAGES FOR DRAINAGE OF SILT ONTO ADJOINING PRO-

222 Md 263, 159 A 2d 632-636 (Ct App 1960).

*Maryland, *Reasonable Descriptors: Descriptors: *Maryiand, *Reasonatic use, *Damages, *Deposition (Sediments), Judicial decisions, Water law, Surface waters, Natural flow, Natural flow doctrine, Civil law, Real property, Property values, Depreciation, Obstruction to flow, Surface drainage, Silts, Mudflows, Elevation, Landfills, Grading.
Identifiers: *Remedies, Damages (Legal aspects).

Plaintiffs sued for damages caused by surface water, silt, and debris draining from defendants' property onto plaintiffs' adjoining land. The trial court awarded plaintiffs \$1000 damages. Defendants, whose land was higher in elevation, placed fill on their lot and had a bulldozer level it off, thereby pushing the new earth very near the boundary with plaintiffs' land. Mud, silt, and debris were washed by rainfall onto plaintiffs land, killing several trees and destroying plaintiffs' vegetables.
When strict application of the civil law rule results in hardship on either the higher or lower landowner, Maryland courts apply the 'reasonableness of use' rule. The appellate court held the plaintiffs were not entitled to recover for the surface water flowing onto their land after the elevation of defendants' property, but they were entitled to recover for defendants' failure to take reasonable precautions to prevent damage from the excess dirt, silt, and debris. After stating the Maryland rule for the measure of damages for injuries to real property, the court upheld the decision holding defendants liable, but reversed and remanded the case for additional testimony on the amount of damages. (Smodish-Fla) W69-02045

HALL V TOMER (DAMAGES FOR DIVERTING SURFACE WATER).

42 West 41-48 (Pa Com Pl 1959).

Descriptors: Ditches, Drainage, Runoff, Storm runoff, *Surface runoff, Surface drainage, *Natural flow doctrine, *Pennsylvania, Precipitation excess, Pipes, Riddance (Legal aspects), Water law, Damages, Judicial decisions.

Defendants' land lay at a higher elevation than that of plaintiff, and was being developed into a housing division with streets running in the direction of plaintiff's land which diverted water onto plaintiff's land. It was found that plaintiff's land lay in the natural water course for water flowing from defendants' land prior to its development. The owner of

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upper land has the right to have surface water flowing over his land discharged through a natural water course onto the land of another. Plaintiff requested that defendants install and maintain drainage ditches and pipes over to other drainage facilities at another highway; that defendants remove all debris from plaintiff's land; and that he be awarded \$1,860.75 in damages. The court ordered defendants to install drainage facilities sufficient to alleviate the problem caused by defendants' streets diverting surface water, but left it to the defendants to determine how this was to be done. Defendants were not required to remove the debris from plaintiff's land as the precipitation that caused it was extremely heavy resulting in defendants' excavations not being entirely responsible for this mud and silt. This problem of causation also resulted in a damage award of \$317.00 instead of that requested by plaintiff. (McDermott-Fla) W69-02046

WARD V CITY OF GEORGETOWN (LIABILITY FOR FLOODING).

28 111 App 2d 447, 171 N E 2d 653 (1961).

Descriptors: *Illinois, Watercourses, Flooding, *Flood damage, Negligent inundation, Damages, Value, Civil law, Judicial decisions, Dams, Crops, *Eminent domain. Cities.

Action by landowners against city for damage to crops and permanent damage to land caused by flooding which was a result of the city's raising of its dam. The court awarded damages to the landowners, because pursuant to the state constitution, private property should not be damaged for public use without just compensation. The evidence showed that the city's dam was a public use and the damage to the plaintiffs' lands was a direct and immediate result of the construction and subsequent modification of the dam. (Scott-Fla) W69-02047

WACHSMUTH V STONE'S MARINA, INC. (RIPARIAN RIGHT OF ACCESS). 26 Misc 2d 466, 214 NYS 2d 15-18 (1960).

Descriptors: *New York, Judicial decisions, *Riparian rights, Barriers, *Access routes, Right-of-way, Navigable waters, Boats, Bays. Identifiers: Limited interference.

Plaintiff sued for a mandatory injunction to require removal of an obstruction, a road crossing, from a waterway. Plaintiff claims that the obstruction, although on defendant's property, deprives plaintiff of his riparian right to gain access to the bay by boat through this waterway. The suit was properly raised under New York statute. The court found that plaintiff rarely used the waterway in question and he had access to the bay from another portion of his land. The construction of the road was not substantial enough to seriously interfere with the use and enjoyment of plaintiff's premises. (Sisserson-Fla) W69-02049

JOHNSON V WILLIAMS (SURFACE DRAINAGE).

121 S E 2d 223-232 (S C 1961).

Descriptors: *Surface drainage, *Watercourses (Legal), Natural flow, Flooding, Flood damage, Surface runoff, *South Carolina, Repulsion (Legal aspects), Riddance (Legal aspects), Water law, Drainage systems, Water control, *Obstruction to flow, Ditches, Drainage, Pipes.

The respondent and the appellant owned adjoining lands. Water from the lands of respondent and other upper landowners drained across the farm of appellant. The appellant obstructed the flow of this drainage and the respondent brought this action to recover for damages alleged sustained by flooding and for an injunction. The basic issue in the case

was whether or not the drainway was a natural watercourse. The respondent contended that it was while the appellant contended that it was not that only surface waters were involved. The obstruction of the flow of surface water is generally not actionable, while the obstruction of the flow of a natural watercourse, if it results in damage to an adjoining landowner, is actionable. This court affirmed stating that there was ample evidence upon which to base the findings of the jury that appellant obstructed a natural watercourse. (Smith-Fla) W69-02051

EVANS V WHEELER (LIABILITY FOR STREAM RELOCATION). 348 S W 2d 500 (Tenn 1961).

Descriptors: Eminent domain, *Tennessee, Diversion, Alteration of flow, *Relocation, *Damages, Value, Market value, Property values, Worth, Appreciation, Civil law, Judicial decisions, Right-of-way, Land appraisal, Watercourses.

Davidson County diverted a stream and rechanneled it so as to completely remove it from plaintiff's land. Eminent domain proceedings were not instituted because of the County's mistaken belief that the stream was entirely within its right of way. The court said that the measure of damages to which plaintiff is entitled is the decrease in the market value of the riparian land by reason of the diversion of the water. No damages were awarded because by diverting the stream the County had increased, rather than decreased, the value of the plaintiff's land. Prior to the diversion plaintiff's land was subject to periodic flooding, while after the diversion it was suitable for development in the same manner as more valuable adjoining tracts of land. No adjustment was made for appreciation of W69-02052

FORMAN V FLORIDA LAND HOLDING COR-PORATION (ACCRETION - LEGAL ASPECTS). State of Florida, Tallahassee.

121 So 2d 284-788 (Fla 1960).

Descriptors: *Florida, *Boundaries (Property), Judicial decision, *Riparian rights, *Accretion (Legal aspects), Erosion, Swamps, Coastal marshes, Legislation, Maps, Oceans, Tidal effects, Atlantic Ocean, Shores, Land, Riparian land, Legal aspects.

Appellants contend that Government Lot 2 claimed by the appellees was swamp and overflow land which was acquired by the State of Florida under the Swamp Land Act of 1850, and as such does not support riparian rights as an appurtenance. Therefore, appellants assert that the 1870 west boundary line of New River Sound constituted an established fixed east line of Government Lot 2. and that the owner of this lot enjoyed no riparian rights resulting from any accretion to its eastern boundary. Riparian rights may be appurtenant to swamp and overflow lands conveyed to the state under the Swamp Land Act. In affirming the decision this court found that the evidence sustained the finding that Government lot 1 had submerged as a result of erosion caused by the severity of the elements and that there was no basis for appellants contention that it became an 'immigrant parcel' of land which had migrated intact directly west to a new location on the boundary of Government Lot 2. (Smith-Fla)

SEABOARD AIR LINE R CO V COUNTY OF CRISP. (FPC - LICENSING). 280 F 2d 873-878 (5th Cir 1960).

Descriptors: *Georgia, Judicial decisions, Legislation, Federal Power Act, *Hydroelectric project licensing, Hydroelectric plants, Rivers, Navigable rivers, Dams, Administrative agencies, *Waterlevels, Damages, Impoundments, Local govern-

ments, *Embankments, Railroads, Eminent domain, Erosion control.

Crisp County, Georgia was empowered by an amendment to the Georgia Constitution to build a dam across the Flint River and to erect and operate a hydroelectric plant. The river at the site where the dam and generating plant were built was navigable and the county was required to procure a license from the FPC. The building of the dam and the consequent raising of the water level damaged an embankment and trestle of the Seaboard Railroad. The county executed a contract with the railroad in 1939, agreeing to repair the damage done at that time and to protect the embankment in the future. The county repaired the damage in 1939, but refused to repair the current damage. The law in Georgia permits counties to be liable upon their contracts only when the state has authorized the incurring of the liability asserted. This court reversed the decision of the district court for the county on the basis of the broad general power of contract granted in the amendment authorizing the project. W69-02054

APPLICABILITY OF RULES OF ACCRETION AND RELICTION SO AS TO CONFER UPON OWNER OF ISLAND OR BAR IN NAVIGABLE STREAM TITLE TO ADDITIONS, C. C. Marvel.

54 ALR 2d 643-655.

Descriptors: *Riparian rights, Riparian land, Judicial decisions, *Accretion (Legal aspects), Islands, Navigable rivers, *Boundaries (Property), *Ownership of beds, Erosion, State governments, Legal aspects, Water law, Mississippi River, Channels, Missouri River, Navigable waters, Legislation.

As a general rule, the owner of an island is entitled to any additions thereto, in the same manner as is the owner of riparian land on the mainland. Both types of owners are equally affected by the existence in a jurisdiction of either of the opposing theories of ownership of the bed of a navigable stream. Under the theory that the state owns the bed, the owner of the island is entitled to all accretions to the island even if the accretions meet other land, or in the absence of a statute to the contrary, if the accretions occupy a part of the stream formerly occupied by the land of another which has eroded away. Under the theory that the riparian owner owns to the middle of the stream, the owner of the island is entitled to accretions to the center of the channel between the island and the mainland. (Smith-Fla)

LIABILITY, AS REGARDS SURFACE WATERS, FOR RAISING SURFACE LEVEL OF LAND, W. E. Shipley. 12 A L R 2d 1338-1352.

Descriptors: Land development, *Land forming, Graded, *Surface drainage, Alteration of flow, Judicial decisions, Surface waters, Diversion, Obstruction to flow, Watercourses (Legal), Water law, *Civil law, Legal aspects, Elevation, Repulsion (Legal aspects), Reasonable use.

One of the ordinary consequences of the filling or grading of land is the diversion of surface water which normally flowed over the land. Because of such diversion, the surface water may flow onto or fail to leave the land of another. The legal problems arising when surface water is diverted by improvements resulting in a general elevation of the surface land are discussed and illustrated by a collection of judicial decisions. Problems created by the blocking of natural or artificial watercourses which drain surface waters are beyond the scope of this annotation. The various jurisdictions are widely divided as to the general rules which govern the rights, duties and liabilities arising from the flow of surface waters. Many jurisdictions have adopted the 'common enemy rule,' others have adopted the

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civil law rule. Both of these rules are discussed at length including certain modifications such as the reasonable user rule. (Smith-Fla) W69-02057

LAND CUT OFF BY RUNNING STREAM. Ga Code Ann Sec 85-1608 (1967).

Descriptors: *Georgia, Legislation, *Streams, *Boundaries (Property), Boundary disputes, Alteration of flow, *Channel flow.

Where a watercourse formed one of the boundary lines of a tract of land, and its course was changed by nature or art so that the present channel cuts off a part of said tract, the processioners and surveyor shall certify the fact and the plat of the surveyor shall plainly mark the present and original channels, designating the exact quantity of land so cut off. (Williams-Fla) W69-02059

PUBLIC WORKS AUTHORIZATIONS, 1968 RIVERS AND HARBORS - FLOOD CONTROL AND MULTIPLE PURPOSE PROJECTS - PART 4

Hearings before the Subcommittee on Flood Control - Rivers and Harbors of the Committee on Public Works, U S Senate 90th Congress, 2nd Session, May 14, 15, 16, 21, 22 and 23, 1968.

Descriptors: United States, Legislation, *Indiana, *Illinois, *Ohio, Flood control, Water supply, River basins, Reservoir sites, *New York, Channel improvement, Drainage systems, Dams, Project planning.

Identifiers: Maintenance costs.

This report to the Subcommittee was on the Wabash River comprehensive study for Indiana, Illinois and Ohio. The main problems indicated were flood control, water quality and supply, and recreation in the Wabash basin. The recommended plan consists of constructing the Louisville, Helm, Big Walnut and Big Blue Reservoirs, the Downeyville Reservoir and the Marion project to meet these water problems. The report on Port Jefferson Harbor, New York indicated inadequate channel depth. The recommended plan calls for enlarging the channel. The Licking River, Ohio, report indicated a flood problem and a need for water quality control and supply. The recommended plan calls for: (1) Utica dam; and (2) improvement of interior drainage and channel enlargement. This report on Buffalo Harbor, New York, revealed that drift in the waterways is hazardous to small boats, clogs sewers and menaces health. The recommended plan calls for maintenance costs to remove the drift. The report on Cleveland Harbor also reveals drift and the recommended plan calls for maintenance costs for removal. (Childs-Fla) W69-02070

PUBLIC WORKS AUTHORIZATIONS, 1968 RIVERS AND HARBORS - FLOOD CONTROL AND MULTIPLE PURPOSE PROJECTS - PART 4

Hearings before the Subcommittee on Flood Control - Rivers and Harbors of the Committee on Public Works, U S Senate 90th Congress, 2nd Session, May 14, 15, 16, 21, 22 and 23, 1968.

Descriptors: United States, *Florida, Legislation, *Beach erosion, Hurricanes, Floods, Landfills, *Harbors, *Navigation, Channel improvements, Local governments, Earthdikes, Drainage systems, Project planning. Identifiers: Florida Board of Conservation.

Identifiers: Florida Board of Conservation.

The Subcommittee considered additional Public Works Authorizations. The next reports were on several Florida projects accompanied by statements from the Florida Board of Conservation. The Dade County report indicated an erosion and hurricane problem causing beach loss and tidal flood-

ing. The recommended plan calls for the construction of a protective beach and dune and periodic beach nourishment. The Brevard County report indicated erosion damage threatening upland improvement and reducing beach area. The recommended plan calls for artificial placement of beach fill. The Port Sutton, Tampa Harbor report in-dicated a navigational problem of insufficient channel depth precluding the use of larger vessels. The recommended plan provides for maintenance of the channel and basin as improved by local interests. The Hillsborough Bay report indicated a hurricane flood problem. The recommended plan calls for an earthfill levee and barrier and construction of a hydraulic model for the study of water utilization and control in the area. The Martin County report showed periodic flooding caused by inadequate drainage and control works. In drought periods irrigation is needed. The recommended plan calls for canals and control structures for gravity drainage. Irrigation features would be deferred. (Childs-Fla) W69-02071

PUBLIC WORKS AUTHORIZATIONS, 1968 RIVERS AND HARBORS - FLOOD CONTROL AND MULTIPLE PURPOSE PROJECTS - PART 4

Hearings before the Subcommittee on Flood Control - Rivers and Harbors of the Committee on Public Works, U S Senate 90th Congress, 2nd Session, May 14, 15, 16, 21, 22 and 23, 1968.

Descriptors: *United States, Legislation, *Massachusetts, Channel improvement, *New Hampshire, Flood protection, Water supply, *North Carolina, Water storage, Delaware, Beach erosion, South Carolina, Maryland, Project planning.

Identifiers: Public Works Authorizations, Corps of Engineers Reports.

The subcommittee considered reports by the Corps of Engineers and heard other testimony on Public Works Authorizations. The report on the Ipswich River, Massachusetts, revealed shoaling at the river mouth hindering recreational boating and commercial fishing. The recommended plan called for a channel, two anchorage areas, and a jetty to prevent entrance shoaling. The report on the Beaver Brook Dam and Reservoir, Keene, New Hampshire revealed a flood problem, a need for water based recreation and water supply. The report on the Cape Fear river basin, North Carolina, revealed flood damage and a need for water storage, water quality control and recreation. The recommended plan calls for a dam and reservoir at the Randleman and Howard Mill sites. The report on the Delaware coast revealed beach erosion. The recommended plan calls for beach widening, bulkhead, stone revetment and sand fence construction. The report on the Cooper River, South Carolina, revealed a navigational problem of serious silting and shoaling. The recommended plan is to redivert the Santee River and construction of a hydroelectric plant. The report on the Six Bridge Project in Maryland indicated a water supply and water quality improvement problem. This plan calls for a concrete gravity-earth structure to create a reservoir. (Childs-Fla) W69-02072

SURFACE WATER IN INDIANA,

Thomas L. Shaffer. Indiana L J, Vol 39, No 1, pp 69-108, 1963. 40 p, 2 tab, 231 ref.

Descriptors: *Indiana, Hydrologic cycle, *Surface waters, *Riparian rights, Topography, Erosion, Evaporation, Repulsion (Legal aspects), Civil law, Flow, Banks, Floodwater, Watercourses (Legal), Irrigation, Streams, Water pollution, *Judicial decisions, Water law. Identifiers: Soil composition, Common law.

The hydrologic cycle is discussed, particularly with reference to Indiana. The effect of topography, soil composition, evaporation, and growing season on the cycle is covered. The civil and common law governing surface water is set forth. Indiana seems to follow the common law as to lower owners and a modified common law position as to upper owners. Generally, the surface water problem is one of disposal. The problem of defining surface water is examined and the factors for consideration in Indiana are: time of flow, banks, local name or not, direction, origin, usefulness, and distance. Indiana seems to view flood water as surface water if it leaves its watercourse once and for all. The author discusses at great length the rights and duties of upper and lower owners, which have evolved through Indiana case law. Conserving surface water helps restore ground water supplies, keeps lake levels high and assures reliable flows in streams. Also, erosion and flood damages caused by the surface water are mitigated. The idea that surface water is a nuisance is out of date. Any water in the state which can be made to contribute to public needs should be marshalled for this purpose and property owners who marshall it reasonably should be given judicial protection. W69-02073

STORM SEWER TUNNEL 'THREADS NEEDLE' BETWEEN HIGHWAY BENTS,

For primary bibliographic entry see Field 08A. For abstract, see . W69-02077

SEWER DEPTH OF FLOW DETERMINATION, For primary bibliographic entry see Field 07C. For abstract, see . W69-02089

STORM SEWAGE SEPARATION BY HELICAL MOTION.

For primary bibliographic entry see Field 05D. For abstract, see . W69-02090

MODEL INVESTIGATIONS OF DIFFERENT TYPES OF STORM-WATER OVERFLOWS AND THEIR EFFECT ON THE SEWAGE WORKS AND THE RECEIVING STREAM,

B. Erfmann.
Technische-Wissenschaftliche Mitt, No 3, 1960.

Descriptors: *Overflow, *Storm runoff, *Water pollution, *Weirs, Design, *Model studies.

Investigations with a model plant are described into the effect of the design and position of storm-water overflows on the distribution of polluting matter between the sewage works and the stream. Weir designs which ensure that the greatest possible amount of polluting matter passes to the sewage works are discussed. W69-02091

THE PERFORMANCE OF STILLING PONDS IN HANDLING SOLIDS,

For primary bibliographic entry see Field 08A. For abstract, see . W69-02092

STORM FLOWS FROM COMBINED SEWERAGE SYSTEMS IN THREE AREAS, A. L. H. Gameson, R. N. Davidson, and J. M.

Threlfall. Instn Publ. Hith Engrs J, Vol 64, pp 182-208, 1965.

Descriptors: *Storm runoff, *Overflow, Discharge (Water).

Identifiers: *Combined sewers, *Calculations.

Results are given of investigations at Northampton, Brighouse, and Bradford on the frequency and duration of operation of storm-sewage overflows on

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combined sewerage systems and on the volume of storm sewage discharged, since this knowledge is required when determining the optimal setting for an overflow. From the results, equations have been developed which were found to fit not only the data from these three systems but also those from a partially-separate system at Luton; some examples are given of the use of the equations to determine the setting so that the overflow would operate only on a certain number of occasions per year or that the average yearly discharge should be a certain percentage of the rainfall.

W69-02093

USE OF STORM WATER OVERFLOWS ON SEWERS: THEIR DESIRABILITY, AND RISKS OF POLLUTION,

J. H. Garner. Survr, Vol 108, p 131, 1949.

Descriptors: *Overflow, Sewers, *Water pollution, *Storm runoff.

Considerable pollution of surface waters is caused by sewage discharged from storm water overflows. Author considers that in many cases improvement could be effected by reducing the number or altering the position of overflows and in some instances larger volumes could be treated at the sewage works.

W69-02094

STORM-WATER CONTROL BY SIPHON SPILLWAYS AT EARLSWOOD SEWAGE WORKS, REIGATE, J. M. Harwood.

J Inst Sew Purif, Pt 2, 1960.

Descriptors: *Siphons, *Spillways, *Storm runoff, *Weirs.

At the Earlswood sewage works of Reigate, Surrey, storm water was formerly separated by means of a normal side weir following the line of the main inlet channel, but this was not satisfactory. It was therefore decided to install a series of siphon spillways. The reasons for this decision are listed, and details of the installation are described. W69-02095

TESTING AND CALIBRATION OF STORM OVERFLOW CONTROL PIPES, K Hutton

Contract Rec; Vol 70, No 23, p 13, 1959.

Descriptors: *Stilling basins, *Overflow, *Flow control, *Storm runoff, Discharge (Water), Velocity, *Instrumentation.
Identifiers: *Suspended solids.

The stilling pond overflow pipe, which provides the most efficient means for the separation of 6 times the dry weather flow from storm water flows, and for removing suspended solids from storm water, is described, and the one in use at Mixenden is presented diagrammatically. Tests carried out at Halifax on this type of overflow and its calibration are given in detail, and show the variation between discharges allowed for in design and those met with in practice. Equations are derived for the determination of several factors including the hydraulic gradient, velocity head, and friction loss. From the studies so far carried out, it was concluded that the stilling pond is the best type of storm overflow at present in general use.

TESTS ON A MODEL STILLING POND WITH SIPHON OVERFLOW,

P. M. Jarrett, H. F. Griffiths, and E. Markland. Civ Eng Publ Works Rev, Vol 59, 346, 1964.

Descriptors: *Stilling basins, *Model studies, *Siphons, *Overflow, *Water pollution control, *Storm runoff, Weirs, Instrumentation. Identifiers: *Suspended solids.

The use of stilling ponds is considered to be the most effective way of reducing pollution from storm-water overflows, since an efficient stilling pond should retain much of the solid matter discharged during the first flush of storm water and subsequently pass it down the sewer as the level falls. The authors have carried out preliminary tests on a model stilling pond equipped with a siphon in place of the usual overflow weir; the results, which are discussed briefly, warrant more detailed investigations, using suspended particles of various sizes over a continuously graded spectrum of specific gravity, to establish optimal proportions for stilling ponds with siphon overflows.

CRITICAL OBSERVATIONS ON THE HYDRAULIC DIMENSIONING OF STATIONARY RAIN OVERFLOWS,

J. Jehne

Wasserwirtsch-Wassertech, Vol 17, No 4, pp 121-127, April 1968.

Descriptors: *Overflow, *Hydraulics, *Storm runoff, Dilution, Sewage sludge.

After presenting the weak points of the notion 'dilution' in hydraulic measurement of stationary rain overflows, the author recommends the specific content (related to the unit of water amount) of one or more components (specific load) as the criteria for the admissible load of the receiving stream. The developed formulas permit: the calculation of the expected upper limit value of the specific load and the calculation of the overflows; the numerical expression of the conditions in case of more overflows from the same collector; and exact information about the effects of sludge whirlup in the collector or about the imperfect mixing of the individual incoming and outcoming amounts. The influence on the load can be expressed by the (temporary or continuous) magnitude change in one of the load determining factors.

A CONTRIBUTION TO HYDRAULIC CALCULATIONS ON LATERALLY-BAFFLED STORM-SEWAGE OVERFLOWS,

G. J. Kallwass.

Thesis, Technische Hochschule, Hannover, 1964, 165 pp.

Descriptors: Design, *Hydraulic design, *Overflow, *Storm runoff, Weirs, Discharge (Water). Identifiers: *Calculations.

In connexion with the design of storm-sewage overflows, pilot-plant experiments were carried out at the Institut fur Hydromechanik, Hannover, to calculate the conditions of flow before and after passage over a weir at varying angles, taking into consideration geometrical characteristics when calculating the discharge after a peak load. The equation used for the calculation is based on those for overflowing weirs. W69-02099

THROTTLE MEASURING DEVICE OF RAINWATER OVERFLOWS,

G. J. Kallwass.

Gas-Wasserfach, Vol 109, No 6, pp 150-155, 1968.

Descriptors: *Storm runoff, *Overflow, Outlets, *Weirs, Flow measurement, *Instrumentation, *Model studies.

Rainwater overflows with high weirs and throttled outlet systems have recently been used to limit the load of receiving streams. The infeed system lying above the weir limits the duration and frequency of the overflow. The efficiency of the throttle line is determined by the diameter, the length, and the slope of the bottom of the line. Because of high costs it is not advisable to undertake any reconstruction of the throttling line or to construct it behind already existing non-throttled rainwater overflows. The same holds true for repairs of errors

caused by incorrect calculations. In such cases, use is made of the throttle stop. Located above the canal network outlet, the stop closes the flow in the upper infeed section of the network. A method is described to calculate one-sided rainwater overflows with throttle stops. This method can be applied in almost all cases in which, in the infeed portion, a normal streaming run-off (t sub N > t sub gr) is observed or in which, in the case of a shooting normal run-off (t sub N < t sub gr). The parameters required for the calculations were obtained on models with circular pipes. However, they can be applied for other cross sections as well, provided the same conditions are observed. $\ensuremath{\mathsf{W}} 69-02100$

THE STORAGE AND DISCHARGE CAPACITIES OF SEWERAGE AND THE OPERATING FREQUENCY OF STORM OVERFLOWS: DUTCH METHOD OF CALCULATION, A.C. J. Koot.

Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Discharge (Water), *Storm runoff, *Overflow, Pumping. Identifiers: *Capacity, Surface permeability, *Calculations

This system is based on the principle that a system must be filled before diluted sewage is discharged into the surface water. It assumes that part of the precipitation received in the impervious area: (a) flows into the sewerage system; (b) is discharged or pumped off near the end of the main sewer; and (c) may be discharged into the surface water via storm overflows. Calculations are restricted to those for the static storage capacity. The figure calculated is the capacity of the sewer pipes between the top of the lowest overflow (s) and the highest water level in the sump of the pumping station, or level at discharge. The available discharge capacity is considered, with schematic representations for both flat and sloping areas shown. A scatter diagram of the amount of rain in mm's plotted against the duration of the rain in minutes for 195 showers of more than 7 mm. which fell in DeBilt, Utrecht, between 1938 and 1948 is also included. On the basis of the given assumptions, it is possible to determine the approximate number of showers giving rise to overflow of sewage for the 11 year period. W69-02101

THE DESIGN AND EFFICIENCY OF STORM WATER OVERFLOWS IN COMBINED SEWERAGE SYSTEMS, H. Lohff.

Gesundheits-Ing, Vol 75, pp 397-9, 1954.

Descriptors: *Overflow, *Storm runoff, *Water pollution, Discharge (Water), Design, *Sewage sludge.

Identifiers: *Combined sewers.

The author discusses the problem of pollution of streams by storm water overflows and methods of reducing both the amount of storm water thus discharged and the polluting matter carried. Alterations in the design of the overflow are suggested with special attention to increasing the height of the overflow sill to form a storage chamber where sludge washed from the sewer could collect. W69-02102

LOSS OF SANITARY SEWAGE THROUGH STORM WATER OVERFLOWS, I.F. McKee

Sewage Works J, Vol 20, pp 589-90, 1948.

Descriptors: *Storm runoff, *Overflow, *Rainfall intensity.

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Identifiers: *Boston (Mass), *Interceptor sewers, *Combined sewers, Capacity.

Data are given on the rainfall at Boston, Mass.; the effect of rainfall on the flow of intercepting sewers of the combined sewerage system; the proportion of sewage in storm water overflows, and the frequency of overflow. It was found that storm water runoff equal in volume to the dry weather flow of domestic sewage was produced when rainfall was 0.01 in/hr. When twice the average dry weather flow was intercepted about 2.7% of the total amount of domestic sewage overflowed. Overflow occurred about 5-6 times/month in the summer. The effects of increasing the capacity of the interceptors on the amount of sewage in the overflow and on the frequency of overflow is discussed W69-02103

LOSS OF SANITARY SEWAGE THROUGH STORM WATER OVERFLOWS,

J. E. McKee. J Boston Soc Civ Eng, Vol 34, No 2, pp 55-80, April 1947.

Descriptors: *Storm runoff, *Overflow, *Rainfall intensity.

Identifiers: *Boston (Mass), *Interceptor sewers, *Combined sewers, Capacity.

In comtemplating design of intercepting sewers, relation between storm run-off and sewage; and similar problems were studied at Boston, Mass; data on rainfall and rainfall probability; run-off from low intensity rainfall; relation between run-off and dry weather sanitary flow; duration and extent of sewage overflows; effect of interceptor capacity on frequency of overflow of sanitary sewage.

ONE WAY TO BYPASS A LARGE SEWER, For primary bibliographic entry see Field 08C. For abstract, see . W69-02105

RECONSTRUCTION OF OVERFLOWS,

W. H. G. Mercer.

In Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Storm runoff, *Overflow, Storms, Design.

Identifiers: *Calculations, *Suspended solids.

The policy adopted by the city of Rochdale to accept all liquid trade wastes made it necessary to recalculate the loads on the entire system. This recalculation led to the decision to reconstruct some of the original storm sewage overflows to accept the additional loads. Since a large number were involved it was decided to reconstruct one overflow on an experimental basis first. Part of the experiment was to determine the conditions when a storm occurred which only just put the overflow into operation. The effect of surcharging the sewer before allowing the overflow to begin was that nearly all floating matter was held back some distance upstream. Matters of public relations undertaken when an overflow in a shopping area was reconstructed are given in detail. Although the work on overflows has formed part of a comprehensive program, the reconstruction of each had its particular problems. Ultimate design was dependent on a number of existing factors, some fixed and some varying with limits. As work progressed, it was observed that: (a) a far greater volume of sewage was being passed to the sewage works; and (b) the discharge of floating matter to the water courses during storms was decreasing. W69-02106

PRACTICAL DESIGN OF STORM SEWAGE OVERFLOWS, P. R. Oakley,

In Symposium on Storm Sewage Overflows, May 4, 1967, sponsored by the Institution of Civil Engineers.

Descriptors: *Design, *Overflow, *Storm runoff, Hydraulics, Stilling basins, Equipment, *Weirs. Identifiers: *Suspended solids.

The extent that the ideals of theory can be realized in the practical design of storm sewage overflows is discussed with special emphasis on efficiency and reliability. Two tests of efficiency for storm water overflows are: (a) hydraulic performance, and (b) separation of suspended solids. Hydraulic efficiency implies that overflow does not commence prematurely and that the base flow does not vary with the rate of overflow. The two possible approaches to efficiency in separation of solids are to use physical methods of restraint or to rely on gravity separation. The relative merits of screening, stilling ponds or vortex action in separation are discussed Reliability is taken to include safety and convenience in operation as well as the more direct meaning. The structure should be designed for a life in excess of 30 years. Power driven devices are best avoided unless adequate and regular maintenance is assured. Emergency by-pass arrangements should be made. A design of 1937 is illustrated and discussed as well as a high weir type overflow. More opportunity is afforded in designing large overflows on new sections of sewer; one such design is shown. No overflow should be located on sewers less than 18 in. dia. or of maximum flow less than 6 cusecs. For small overflows the storage type are suitable; with larger flows only limited storage is likely to be practicable. W69-02107

MAINTENANCE OF STORM FLOW REGULATORS.

For primary bibliographic entry see Field 08C. For abstract, see . W69-02108

SECONDARY MOTIONS APPLIED TO STORM SEWAGE OVERFLOWS,

T. M. Prus-Chacinski, and J. W. Wielogorski. In Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Storm runoff, *Overflow, *Design, *Model studies.

Identifiers: *Calculations, *Suspended solids.

A model was used to study the possibility of using the helical flow in short bends as a basis for the design of storm sewage overflows. For a short bend a convenient measure of the intensity of the helix is the angle between the circumferential direction and the direction of flow very near to the bed of the channel. Several expressions were developed to predict the value of this angle. There is evidence that in a bend longer than 0=90 the intensity of the helix decreases, and that eventually at 0=180 the direction of water near the bed reverses toward the outer wall. If a relatively short bend is followed by a second of opposite direction, the helix generated in the former suppresses development of the helix in the latter. However, an S channel may be more convenient to use and was therefore investigated. The symmetrical S shape of the channel was chosen so that a number of possible configurations of the relative positions of slots and overflows could be investigated by reversing the channel. Figures are included to show the bed load distribution both with slots closed and opened; the relationship between suspended load and flow through the slot; and the relationship between bed angle in the first bend and Reynolds' number in a semicircular channel. It is concluded that the results of the investigation may be used to design an effective and cheap storm sewage overflow. W69-02109

ON MEASUREMENTS OF STORM-SEWAGE OVERFLOWS - A GRAPHICAL METHOD, L. Schmitz. Gesundheits-Ing, Vol 85, p 363, 1964.

Descriptors: *Storm runoff, *Overflow, *Flow measurement.
Identifiers: *Calculations, Bernoulli's theorem.

Owing to the inaccuracy and difficulty of existing methods of calculations for storm-sewage overflows, a graphical method has been developed, based on Bernoulli's equation. By this method not only can liquid flow through non-uniform pipes measured, but with the application of Bernoulli's theoreum the difference in pressure between the top and bottom ends of the pipe and/or the required section of such vertical tapered pipe can be calculated. Values for the pressure drop, throat diameter and throat length for a minimum pipe-fall of 0.5 per cent and for the friction coefficient of 0.15 and 0.30 in relation to the volume of flow and the head of water are given. Diagrams and tables together with a worked example support the author's method.

W69-02111

MEASUREMENT OF STORM WATER OUTLETS IN COMBINED SEWERS BY THE THROTTLE-PIPE PROCESS,

L. Schmitz.

Gesundheitsing, Vol 79, p 323, 1958.

Descriptors: *Storm runoff, *Outlets, *Overflow, Weirs, Instrumentation.
Identifiers: *Combined sewers, *Calculations.

After discussing the differences between stormwater overflows in combined sewers and straight vertical-flow weirs, the author gives diagrams for the calculation of storm-water overflows when the following pipe is designed as a throttle pipe. W69-02112

STORM-WATER OVERFLOWS: THE OPERATION AND DESIGN OF A STILLIING POND, D. E. Sharpe, and T. W. Kirkbride. Proc Instn Civ Engrs, Vol 13, p 445, 1959.

Descriptors: *Storm runoff, *Overflow, *Design, *Stilling basins, *Flow control, Water pollution, *Model studies.

In designing storm-water overflows, the use of stilling ponds has many advantages as it not only permits comparatively accurate regulation of the flow but also results in less polluting matter being discharged. Model experiments were carried out on the operation of stilling-pond overflows with a view to determining the conditions limiting chamber design and to deriving suitable design standards. The flow patterns within a stilling pond were first investigated and the limiting conditions deduced therefrom are presented in a simple form for design application. The applicability of the results to the performance of full-scale overflows is being studied.

DESIGN, CONSTRUCTION AND PERFORMANCE OF VORTEX OVERFLOWS, B. Smisson

Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Design, *Construction, *Overflow, *Model studies, Outlets, Storm runoff, Rainfall intensity.

Identifiers: *Suspended solids, Calculations.

Using hydraulic models, research was carried out on comparatively small tanks using rotary motion induced by the kinetic energy of the sewage. A considerable increase in the amount of solids concentrated in the foul-water outlet over that due only to gravity was found. The program covered devices with prototype retention times from 20 secs. to 20 min. with energy levels at inlet from 0.05 to 20 ft. lbs./lb. Two full-sized overflow chambers have

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been built and observed in operation for several years. The model separators tested were of three types. The largest separator is illustrated and described. The results obtained at a 5 min. retention time, with crude macerated sewage having a mean strength of 230 p.p.m. suspended solids, are shown. It was found that a very significant degree of separation took place. To achieve satisfactory conditions of flow many alterations in shape had to be made, in particular a deflecting wall alongside the in-coming sewer. Floating solids were easy to retain by dip-plate. The number of occasions on which the overflow operates per year and the duration of such occasions would give a better criterion for design than any estimate of what should be left in the sewer. A method of design based on statistical analysis of rainfall is given, which enables the designer to choose the size of overflow best suited for any particular site. W69-02114

THE PROBLEMS OF STORM-WATER OVER-FLOWS,

V. Stalmann, and G. Warg. Gesundheitsing, Vol 81, p 257, 1960.

Descriptors: *Storm runoff, *Overflow, Design, Flow measurement.

Identifiers: *Storm sewers, *Calculations, *Capaci-

The authors discuss calculations of flow in pipes and the dimensions and design of storm-water over-W69-02115

PROBLEM OF DESIGN OF INTERCEPTING DEVICES WITH OVERFLOW WEIRS IN COM-BINED SEWER SYSTEMS,

G. Tison, Jr. Int Assn for Hydraulic Res, 11th Cong, Leningrad, Vol 2, paper 2.11.9 p.

Descriptors: *Overflow, *Weirs, *Design, *Storm runoff, Sedimentation Identifiers: *Combined sewers.

Problem of design of intercepting devices with overflow weirs in combined sewer systems; problem is considered in relation to transportation of sediment which is kept away from watercourse receiving sewer flow; theory and experiments in laboratory show that laterally designed weir to divert storm water peak flow directly into watercourse, is poor design as it also removes sediment and brings it into river. W69-02117

HOW TO PLACE STORM SPILLWAY IN COM-BINED STORM AND SANITARY SEWER SYSTEM,

G. Tison, and V. Vukmirovic Rev C, Vol 4, No 1, pp 7-11, 1966.

Descriptors: *Overflow, *Storm runoff, *Design, Sedimentation Identifiers: *Combined sewers.

How to place storm spillway in combined storm and sanitary sewer system; problem is considered in relation to transportation of sediment which is to be kept away from watercourse receiving sewer discharge; theoretical considerations and laboratory tests show that laterally designed spillways for diverting stormwater peak flow into watercourse did not perform satisfactorily; improved spillway designs are discussed and experimental results obtained are shown in diagrams. W69-02118

HYDRAULIC ASSUMPTIONS IN CALCULAT-ING STORM-WATER OVERFLOWS, H Wagner, and G. J. Kallwass Gas Wasserfach, Vol 101, p 660, 1960.

Descriptors *Storm runoff. *Overflow, *Design. Hydraulies
Identifiers *Calculations

The commonly used methods of calculation for storm-water overflows are not suitable for modern designs. The authors discuss conditions of flow, run-off curves, and the friction coefficient and give a diagram for calculation of flow conditions in different shapes of sewer. Sources of error are conside red. W69-02119

THE EFFECT OF DELAYED DISCHARGE ON CALCULATION OF STORM-SEWAGE OVERFLOWS.

G. Warg.

Gas Wasserfach, Vol 107, pp 85-89, 1966.

Descriptors: *Overflow, *Storm runoff, Discharge (Water), Design, *Hydrographs

Identifiers: *Calculations, Munich (Germany), Capacity, Surface permeability, *Urban hydrology, Storage tanks.

The author discusses theoretically the effect of delayed discharge of rain water on the design calculations and measurements of storm-sewage overflows and gives a detailed account of the measurements which were carried out in the sewerage system at Munich to evaluate the effects on discharge capacity, intensity and duration of discharge, load on the receiving water, and dimensions of the sewerage system. He suggests the use of a specially-developed hydrograph system to calculate and allow for changes in permeability at peak flows and to assess the maximal area likely to be covered during rain storms. Tables and nomographs which are included can also be used to calculate the effects of delay on design calculations for storm-sewage plants and flood retention basins. W 69-02120

THE PROBLEM OF SEPARATION IN PLANNING SEWER SYSTEMS,

R. Camp

J Water Poll Control Fed, Vol 38, No 12, pp 1959-1962, Dec 1966.

Descriptors *Overflow, *Sewers, *Water pollu-

tion. Construction costs
Identifiers "Sewer separation. "Combined sewers. *Storm sewers. Suspended solids.

Sewers originally were constructed to drain cellars and land, and later were permitted to carry sanitary wastes. Many older cities in the United States have the combined type of sewer system and now face the need for separate systems for sanitary waste-water and stormwater. The costs are estimated to be \$10,000-\$20,000 acre (\$25,000-\$50,000 ha). not including the cost of possible repairs to storm sewers. Although only three percent of the annual wastewater production is discharged by combined sewer overflows, greater amounts of bacteria and suspended solids are dislodged by high flows after storms. Other methods proposed to alleviate over-flow effects are not so effective as separation We9-02121

OVERFLOWS OF SANITARY SEWAGE FROM COMBINED SEWERAGE SYSTEMS.

Thomas R. Camp

Sewage and Ind Wastes, Vol 31, No 4, April 1959.

Descriptors *Overflow, *Storm runoff, Rainfall in-

Identifiers *Capacity. *Interceptor sewers. *Comhined sewers

The author notes that it has been shown that the average dry weather flow of sanitary sewage is approximately equal to the runoff from a rainstorm having an intensit, of anout 100 in her For inter-coptors having a supacity of 2 t dry weather flow, more than 90 per cent of sanitary sewage is discharged in the overflows with a rainfall intensity of 0.2 in/hr or more. With interceptors having capacity of 5 x dry weather flow, about 76 per cent of sanitary sewage is lost during rainstorms having an intensity of 0.2 in/hr and about 90 percent is lost during rainstorms having an intensity of 0.5 in/hr. Frequency of overflows indicate that one may occur every 5 to 6 days during summer with interceptors designed for 1.5 to 3 x average dry weather flow Chart of frequency of overflows in days mo vs. capacity of interceptors in terms of average dry weather flow and variable time of concentration. Wi69-02122

IMPROVEMENTS IN SYSTEMS OF 'COM-BINED' SEWERAGE,

R. C. Carter

J Instn Sanit Engrs, Vol 49, pp 105-27, 1950.

Descriptors: Water pollution control, *Storm runoff, *Overflow, *Sedimentation, Sewage effluent, Sewage sludge. Identifiers: *Combined sewers, *Storage tanks, In-

terceptor sewers, *Capacity.

The author discusses the possibility of reducing pollution caused by discharge of storm water from combined sewers. It would not be economical to build sewers large enough to carry the max. flow to be expected, for example once each year, but storm overflows which discharge to a stream when the flow exceeds 6 x dry-weather flow cause considerable pollution. Storm tanks are a more satisfactory method of dealing with storm water, as sedimentation can take place and the effluent when the tank overflows is of a less polluting nature. It is sug-gested that an existing combined sewerage system could be expanded by constructing large storm water balancing tanks at various points on the main intercepting sewer Storm water could be stored in these tanks and discharged to the sewers as capacity is available A method for calculating the required capacity of the storm water balancing tanks is shown in a table. In discussion, Bevan, E V. Ackers, G. L., and Towsend, G. B., all stated that the chief difficulty with the system proposed would be the removal of the sludge which would accumulate in the balancing tanks and might give rise to septic conditions. W69-02123

IMPROVEMENTS IN SYSTEMS OF COMBINED SEWERAGE.

R C Carter

Survr, Vol 108, No 3019, p 743, Dec 16, 1949.

Descriptors: *Storm runoff, *Overflow, *Weirs, Design, Pumping, Treatment Identifiers. *Storage tanks, Suspended solids

The author states that storm overflow weirs are an illogical weakness in design and should be eliminated wherever possible. Overflow from storm tanks is much to be preferred to storm sewer overflows as the overflow from the tanks has been rid of virtually all settleable suspended matter Author derives a procedure utilizing storm balancing tanks which take excess storm water from upper laterals and later return the flow by pumping. Thus the peaks are removed and all storm water ultimately gets treatment, either total or at least storm tank.
W69-02124

ESTIMATION OF THE FLOOD FLOW AND DISCHARGE COEFFICIENT IN SEWERAGE SYSTEMS, T Dimchev.

Trud Nauchnoizsled Inst Vodosnab Kanaliz Sanit Tekh, Sofia, Vol 1, pp 53-78, 1964.

Descriptors. *Sewage treatment, *Discharge (Water). Rainfall intensity Identifiers. *Calculations, *Urban drainage

Hydrological observations made in 1958-61 in an area drained by part of the Sofia sewerage system

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are reported and analyzed mathematically with reference to the dry-weather flow and to peak discharges and discharge coefficients in the main sewer, including the effects of surface detention of rain water (which varies with the intensity of rainfall), duration of rainfall (which is inversely related to the peak flow), and the free volume in the sewer. W69-02125

POLLUTION CONTROL FOR STORM WATERS AND COMBINED SEWER OVERFLOWS,

D. D. Dunbar, and J. G. F. Henry. Water and Pollution Control, Vol 105, No 11, p 41, 45, 47, 52-3, Nov 1967.

Descriptors: *Water pollution control, *Storm runoff, *Overflow, Design.

Identifiers: *Combined sewers, Capacity, *Intercepting sewers, *Storage tanks, Canada, United States.

Methods and practices in United States and Canada to improve combined sewer efficiency are discussed; problem of how large intercepting sewer capacities should be in relation to average dry weather flow in combined sewer system is dealt with; design of storm holding tanks. W69-02127

TROUBLE-FREE COMBINED SEWERAGE SYSTEMS,

For primary bibliographic entry see Field 08A. For abstract, see . W69-02128

AKRON MONITORS COMBINED SEWER OVERFLOWS.

For primary bibliographic entry see Field 07B. For abstract, see . W69-02130

STORM WATER AND COMBINED SEWAGE OVERFLOWS,

For primary bibliographic entry see Field 05D. For abstract, see . W69-02131

INTERCEPTING SEWERS AND STORM STANDBY TANKS AT COLUMBUS, OHIO, J. H. Gregory, R. H. Simpson, and O. Bonney. ASCE Proc, Vol 59, p 8, Oct 1933.

Descriptors: Design, Construction, *Overflow, *Rainfall intensity, *Water pollution. Identifiers: *Storage tanks, *Interceptor sewers, Columbus (Ohio).

Design, construction, and operation of sewerage system extension which is to provide for estimated population of 643,000 in 1960; overflow of sewage to rivers and streams; relieving unsanitary conditions in Scioto River and in Alum Creek; intensity, duration and frequency rainfall curves; function of storm standby tanks; cost data.

W69-02132

COMBINED SYSTEM OF SEWERAGE WITH LIMITED RAW WATER INLET,

Walo Von Greyerz.

Trans of Int Conf on Sanit Eng, London, pp 170-80 1924

Descriptors: Pipes, Sewers, *Storm runoff, *Rainfall intensity, *Runoff forecasting, Drainage systems, *Intakes, Construction costs.

Identifiers: *Combined sewers, Capacity, *Cellar Reading.

The combined system of sewerage while having many advantages is at times criticized because of excessive cost on account of the large pipe sizes required to accomodate the maximum run-off from severe storms which are of short duration. Lack of

attention to this condition results in flooded cellars. These objections may be overcome to a large extent by designing the inlets for a limited capacity which the sewer can accomodate and utilizing the storage capacity of the streets to hold the surplus runoff. The streets are thus temporarily flooded to a depth of an inch or two. When the rate of precipitation slackens the stored water quickly drains off through the inlets. This limitation of rain water inlets unites both the simplicity and efficiency of the combined system and two of the advantages of the separate system, namely freedom from risk of cellar flooding and reduced construc-tion cost. Data are presented for the town of Falkenburg for which such a system was designed, taking into account the various street grades and resultant gutter capacities. The methods of computing rates of run-off, inlet sizes, etc. are given in some detail. The discussion disclosed that this method was also in use in India and Panama. W69-02133

RATIONAL DETERMINATION OF STORM OVERFLOWS FROM INTERCEPTING SEWERS,

S. G. Hess, and F. G. Manning. Sewage and Industrial Wastes, Vol 22, pp 145-53, 1950

Descriptors: Design, *Overflow, Storms, Runoff. Identifiers: *Interceptor sewers, *Combined sewers.

A method is described for designing intercepters for use with combined sewer systems based on dry weather flow and run-off of a selected storm. W69-02134

STORM WATER OVERFLOW IN EXISTING COMBINED SEWERS,

H. Hoffman. Bauamt Gemeindebau, Vol 31, p 269, 1958.

Descriptors: Design, Sewers, *Storm runoff, *Overflow, Sewage treatment, *Oxidation lagoons, *Hydraulic design.
Identifiers: *Combined sewers.

The author describes the design of a sewer section by which storm water up to a given dilution is retained and can be discharged to an oxidation pit before reaching the stream. Hydraulic requirements are discussed and a sketch plan is given. W69-02135

WATER SUPPLIES AND SEWAGE DISPOSAL IN BERLIN, For primary bibliographic entry see Field 03B.

For primary bibliographic entry see Field 03B. For abstract, see . W69-02136

EQUIPMENT, METHODS AND RESULTS FROM WASHINGTON, D C, COMBINED SEWER OVERFLOW STUDIES,

C. Frank Johnson.
J Water Poll Control Fed, Vol 33, July 1961.

Descriptors: *Overflow, Design, Sewage treatment. Identifiers: *Urban drainage, *Combined sewers, Washington, D.C.

The study provided city officials with engineering estimates of the actual overflows of sanitary sewage, both present and future, which were of great help in developing and promoting the program of sewerage improvements.

W69-02137

ADVANTAGES AND PROBLEMS OF COMBINED SEWERAGE SYSTEMS, P. Kisser

Gesundheitsing, Vol 81, 245, 1960.

Descriptors: Sewers, Design, *Storm runoff, *Overflow, Sedimentation.

Identifiers: *Combined sewers, *Capacity, *Storage tanks.

The author discusses the advantages of combined over separate sewerage systems and the design and dimensions of storm-water overflows and sedimentation tanks. W69-02138

ASCE COMBINED SEWER SEPARATION PROJECT PROGRESS,

For primary bibliographic entry see Field 08A. For abstract, see . W69-02142

WEST HARTLEPOOL SEWERAGE SCHEME WILL CLEAN BEACHES,

J. S. Miles

Munic Eng, London, Vol 141, p 47, 1964.

Descriptors: *Storm runoff, *Overflow, *Outlets, Pumping, Water pollution control, *Recreation facilities.

Identifiers: *Combined sewers, Great Britain.

Work is in progress on a major sewerage scheme for West Hartlepool C.B.C., aimed at cleaning up 3 miles of beach and inshore waters between Newburn Bridge and the mouth of the river Tees. West Hartlepool is sewered on the combined system, most of the borough being drained through 3 outfalls. The scheme will be carried out in 2 main stages, providing first for the reconstruction of the existing outfalls as storm-water overflows and the construction of 3 pumping stations together with means of mascerating the sewage, and second, if conditions in Hartlepool bay are found to be suitable, for the laying of a long outfall buried in the sea bed. W69-02143

DESIGN OF RAIN OVERFALLS IN DRAINAGE NETWORKS AND SEWAGE TREATMENT PLANTS,

For primary bibliographic entry see Field 05D. For abstract, see . W69-02144

EFFECT OF VARIOUS STORM-WATER PROTECTIVE MEASURES ON THE SEWAGE SYSTEM,

For primary bibliographic entry see Field 05D. For abstract, see . W69-02145

FEASIBILITY OF COMBINED SEWER SYSTEMS, C. L. Palmer.

J Water Poll Control Fed, Vol 35, 162, Feb 1963.

Descriptors: *Design, Storm runoff, Rainfall intensity, Water quality, Discharge (Water). Identifiers: *Combined sewers, *Storage tanks, *Capacity.

Any properly designed and constructed combined sewer, without making use of the storm water storage, will produce results in the range of 98 per cent efficiency and any expenditure of public funds to improve its operation should not be made until necessity can be clearly shown. The adoption of the plan of designing storm water storage into combined systems to the extent possible or desirable, will increase the efficiency of any combined system correspondingly. Generally speaking, the designing of storm water storage into a combined system increases the cost very little. Adding this feature to an existing system would cost more but would still not be a major expenditure. Separate systems will discharge to the receiving waters with every storm exceeding 0.03 in/hr or about 89 times each year for the area studied, and the quality of the stormwater discharge will be objectionable and closely comparable to that from a combined system. Combined systems, designed to make use of 'volumetric

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storage' for the containment of storm water, and based on the volume of a 1-year storm, would discharge to the receiving water only from 3 to 5 times each year, with a duration of about 0.4 per cent of total time, which corresponds to an efficiency of about 99.6 per cent. W69-02146

COMBINED SEWER OVERFLOWS.

For primary bibliographic entry see Field 05B. For abstract, see . W69-02147

FREQUENCY OF FLOW OVER STORM-WATER OVERFLOWS AND STORAGE POSSI-BILITIES IN THE SEWERAGE SYSTEM,

Gas Wasserfach, Vol 103, p 84, 1962.

Descriptors: *Storm runoff, *Overflow. Identifiers: Capacity.

From investigations of the frequency of action of storm-water overflows, the factors which must be taken into account in calculations are discussed and the possibility and importance of increasing the storage capacity of the sewerage system are considered W69-02148

NEW PRINCIPLES FOR THE ARRANGEMENT OF STORM WATER OVERFLOWS, S. Pfeiff.

Gesundheits-Ing, Vol 79, pp 208-13, 1958.

Descriptors: Storm runoff, *Overflow, Design, Construction Identifiers: *Combined sewers, *Calculations.

Variations in the requirements for storm water overflows in combined sewerage systems are discussed and the generally accepted process of calculation is described. The basic requirements of overflows and the extent to which these are met by modern methods of construction are considered. W69-02149

NEW PROCESS FOR SIMPLE CALCULATION OF DILUTION VALUES FOR STORM WATER OVERFLOWS IN COMBINED SEWERAGE SYSTEMS,

S. Pfeiff

Gesundheits-Ing, Vol 77, pp 74-7, 1956.

Descriptors: *Storm runoff, *Overflow. Identifiers: *Calculations, *Dilution, *Combined

The author discusses the uncertainties involved in the usual processes for the calculation of storm water overflows with the help of fixed dilution figures. He recommends the use of local frequency curves based on rainfall statistics, from which in each case a value can be determined for the rainfall limit at which the overflow comes into action. He shows how the overflow and the dilution can be reliably calculated from this limiting figure. W69-02150

UNDERFLOW SEWERS FOR CHICAGO. Milton Pikarsky, and C. J. Keifer. Civ Eng, Vol 37, No 5, pp 62-65, May 1967.

Descriptors: *Tunnels, *Tunnel construction, *Discharge (Water), *Construction costs, *Computer programs, *Overflow, Water pollution. Identifiers: *Combined sewers, *Chicago (III), *Storage tanks, 'Mole' tunneling.

Chicago plans to use a tunneling mole to construct a large tunnel under the rivers and canals into which all of its combined sewers would discharge. The cost of building the tunnel, referred to as the 'underflow mainstream', using this method is \$2 million less than that for the conventional open-cut method of construction. The underflow system was simulated by a computer study, the results of which are tabulated. It is felt that the underflow sewer will demonstrate the feasibility of constructing economically a detention resevoir to greatly reduce the river pollution cuased by overflows from combined sewers, far below the surface in public right of way, while providing the conveyance capacity to reduce basement and underpass flooding. It should also demonstrate the practicability of constructing an enlarged underflow mainstream system to serve the entire City of Chicago and the surrounding metropolitan area. W69-02151

EFFECT OF STORM WATER ON THE SEWERAGE SYSTEM AND THE RECEIVING STREAMS,

F. Popel.

Kommunalwirtschaft, Vol 9, p 340, 1957.

Descriptors: *Storm runoff, *Planning, *Overflow, *Water pollution.

Identifiers: Urban drainage, *Combined sewers.

The author discusses, with special reference to planning of new towns, the effect on streams of storm water overflows in combined sewerage systems. Calculation of the permissible amount must be based on the annual amount of discharge and of polluting matter in it, the self-purifying capacity of the stream, and the use made of the stream water. Investigations are required into the condition of the storm water in modern conditions of traffic and efforts should be made to develop a reliable method of assessing the self-purifying power of a stream receiving sudden discharges of polluting matter. W69-02153

EXTENSIVE SEWERAGE WILL CURB POLLU-TION OF A BAY, Frederick E. Potter.

Pub Works, Vol 95, pp 104-05, Oct 1946.

Descriptors: *Water pollution control, *Sewage treatment, Outlets, Estuaries, Construction costs Identifiers: *Combined sewers, *Interceptor sewers

Article discusses the pollution problems encountered by the City of Portland, Maine. The municipality is subdivided into nine watersheds, all of which drain to tidal water outlets. The effect of tides plus combined sewerage discharge from the heavily populated areas around 'Back Cove' has created an undesirable situation. Initially, a master plan was developed in 1943 to eliminate pollution within this area by construction of interceptor sewers, pumping stations, treatment plant, and outfall sewer. Recently, construction was completed on the south shore of 'Back Cove' at an expenditure of approximately \$1 1/2 million. Construction is expected to begin shortly on the remaining portions of the sewage treatment facilities around Back Cove Bay. W69-02154

THE STORM-WATER COMPROMISE. F. J. Ribbius, and G. Kragt.

Gas Wasserfach, Vol 103, p 498, 1962.

Descriptors: *Storm runoff, *Water pollution control, *Overflow, *Design, Sewage sludge, Pumping. Identifiers: *Combined sewers, *Dilution, *Calculations, Capacity, *Netherlands.

On the basis of experience in the Netherlands the authors discuss the design of combined sewerage systems and suitable compromises between the requirements of sewage purification and prevention of pollution of streams, with special reference to the calculation of dilution and the design of storm overflows. To avoid the risk of pollution by stirred-up sludge at storm overflows, methods are

developed for calculating the frequency of overflow and the relation of storage to discharge capacity with reference to the installation of rainwater pumps. Graphs for the calculations required for the application of these principles are given and their application to projects for combined sewerage systems is discussed. W69-02155

IMPROVING THE EFFICIENCY OF EXISTING INTERCEPTORS.

Erik Riis-Carstensen.

Sewage and Industrial Wastes, Oct 1955.

Descriptors: *Storm runoff, Rainfall intensity, *Biochemical oxygen demand. Identifiers: *Interceptor sewers, *Buffalo (N. Y.), *Suspended solids, *Storage tanks.

For the Buffalo New York area, author has derived a characteristic factor for a district 'Ch' which is a ratio of average dry weather flow (gpd) to the runoff (cfs) during a uniform rainfall of 1 inch/hr (Ch d over c). Study of sewage quality or strength during a 0.55 inch/rain indicates flow doubled, suspended solids 4-5 times, BOD in ppm decreased about 1/3, but total load was higher. During the rain the flow was 5 times and the suspended solids rose to 1220 ppm over an average dry weather concentration of 186 ppm. Author stresses point that the biggest contributor to the suspended solids is the material deposited in the sewers themselves during dwf. Recommends that sewers be constructed to be self-cleansing and also favors small storm water tanks be located on laterals and branches, storm water collected would augment dwf and help keep sewers clean. W69-02156

FLOODED-TUNNEL INTERCEPTOR SYSTEM FOR THE METROPOLITAN ST. LOUIS SEWER DISTRICT,

W. G. Shifrin, G. K. Hasegawa, and V. C. Lischer.

J Water Poll Control Fed, Vol 39, pp 313-333, 1967.

Descriptors: *Drainage systems, *Storm runoff, Discharge (Water), Pumping, *Tunnels, Design,

Construction.

Lastifiers: *Interceptor sewers, *Combined sewers, *Urban drainage, St. Louis (Mo).

St. Louis, Mo., is divided into three main drainage areas, draining respectively to the Mississippi River, Coldwater Creek, and Sugar Creek. A new sewage works is to be constructed at Bissell Point to serve the northern part of the Mississippi River drainage area, where at present there is a combined sewerage system discharging untreated sewage and storm run-off direct to the river. The advantages and disadvantages of different types of intercepting sewer to carry the sewage to the treatment plant were studied, and it was decided to install the flooded-tunnel type, in which the sewage is allowed to rise in the wet well of the pumping station at the treatment plant to such a level that the upstream hydraulic gradient allows all diversion structures to operate with a free fall as in a gravity system. The design and construction of the interceptor system are outlined and the proposed method of operation, which will depend on river stage and weather conditions, is described in detail. W69-02158

DIVERSION FACTORS FOR COMBINED SEWERS BASED ON SEWAGE AND STREAM ANALYSES,

R. J. Theroux, and R. L. Meek. Eng News Rec, Vol 139, p 734, 1947.

Descriptors: *Storm runoff, *Overflow, Biochemical oxygen demand, Dissolved oxygen. Identifiers: *Combined sewers, *Interceptor sewers, *Capacity.

WATER QUANTITY MANAGEMENT AND CONTROL-Field 04

Control of Water on the Surface—Group 4A

A rational method of determining the diversion factor for storm overflow is described in which the organic load of the sewage, in terms of BOD, is balanced against the purifying power of the stream as indicated by the flow, deoxygenation, and reaeration consts., BOD, and dissolved oxygen content of the water above the point of diversion. The method enables the maintenance of safe dissolved oxygen contents in the receiving stream without providing unneeded interceptor capacity. The diversion factor should not be less than 1.5. W69-02160

ONE CITY'S APPROACH TO THE PROBLEM OF COMBINED SEWAGE OVERFLOWS, D. H. Waller.

Water Sewage Works, Vol 114, pp 113-117, 1967.

Descriptors: *Overflow, *Sewage treatment, *Chlorination, Discharge (Water).
Identifiers: *Interceptor sewers, *Storage tanks, Urban drainage, *Combined sewers.

A description is given of the design and operation of one of two retention tanks constructed to prevent overflows into Halifax Harbour from the 'Arm sewer', an interceptor sewer which drains the west and north-west sections of Halifax, Novia Scotia, which are served almost entirely by combined sewers. The tank, which has a capacity of 1 mil. gal, is provided with an aerated detritus tank through which dry-weather flow passes direct to the interceptor sewer after screening; but when flow in the sewer reaches a maximal level, passage through the detritus tanks is stopped, and the retention tank fills, providing 15-min detention at a design peak flow of 150 ft (3) per sec before overflowing to the Arm sewer. Arrangements are made for chlorination to continue as long as the rate of inflow exceeds the rate of outflow to the interceptor. If the intensity and duration of the storm are sufficient to fill the tank, the chlorinated sewage is discharged to the harbour. W69-02161

COMBINED VS SEPARATE SYSTEMS OF SEWERAGE.

For primary bibliographic entry see Field 05B. For abstract, see . W69-02163

WORKS DESIGN AND WET WEATHER FLOWS,

For primary bibliographic entry see Field 05D. For abstract, see . W69-02164

CORRECTING STORM-WATER INFILTRA-TION, TONAWANDA, NEW YORK, For primary bibliographic entry see Field 08A. For abstract, see W69-02165

REDUCTION OF HYDRAULIC SEWER LOAD-ING BY DOWNSPOUT REMOVAL, Gerald L. Peters, and A. Paul Troemper.

No further identification available.

Descriptors: *Sewers, *Overflow, Storm runoff. Identifiers: *Downspouts.

Methods used and results obtained to correct overloading of sewers by disconnecting roof downspouts from sewer systems in Springfield, IIlinois are described. A description of the system existing before the program was initiated is given; data from engineering studies is presented. After the downspout removal program was decided on for suburban Springfield, inspections were made and voluntary compliance by property owners reduced the problem. Administrative and technical problems of the program for the city of Springfield are described. Results of the program are given in tables and copies of letters used are included.

Costs, complaints and reduction of the overflow problem due to the program are discussed. W69-02166

DESIGN CONSIDERATIONS FOR SANITARY SEWER EXTENSIONS,

Mississippi State Univ., State College. Lloyd R. Robinson.

Water Sewage Works, Vol 114, No 7, pp 250-254, July 1967

Descriptors: *Design, *Sewers, *Storm runoff, *Overflow. Identifiers: *Urban drainage.

The results of a study made for Kansas City to determine dry weather flows from housing developments, apartments, industries and commercial establishments are discussed. No wet weather flows were measured but in a study of the flow record at one sewage treatment plant serving a residential area, as little as 0.6 in. of rain caused the recorder capacity of 0.008 cfs/acre to be exceeded. W69-02172

STORM WATER IN SANITARY SEWERS,

V. W. Sauer

Sewage and Industrial Wastes, Vol 24, pp 116-70,

Descriptors: *Storm runoff, *Sewers.

Measures taken at Central Contra Costa Sanitary District, California, to prevent storm water entering the sewers designed to carry sewage and trade waste waters are discussed. W69-02175

A STUDY OF STORMWATER INFILTRATION INTO SANITARY SEWERS, Lloyd W. Weller, and Myron K. Nelson.

J Water Poll Control Fed, Vol 35, p 762, June 1963.

Descriptors: *Storm runoff, Surface drainage. Identifiers: *Sewer infiltration, *Urban drainage, Kansas City (Mo).

This is a discussion of the conduct and findings of a study of a sewer district with a present population of 50,000 (70,000 ultimate) located in the metropolitan area of Kansas City, Missouri. The scope and objectives of this study as regards stormwater infiltration were: '(1) to make a surface drainage survey of selected areas and a surface inspection of the main sewers to find if any conditions promote the entry of surface water into sanitary sewers, and (2) to collect and evaluate data on sewer use and sewage flows.' A total sewer flow of 104.33 mgd (0.0215 cfs/acre) is developed during large rain storms and it is concluded that 'even during a period of moderate precipitation the major portions of the flow are from sources other than the water-using plumbing fixtures in the residences and public buildings within the district.' During these periods the major source of sewer flow is ground water, presumably from foundations drains used throughout the district. Additional local factors influencing sewer flow are reviewed. W69-02177

THE DESIGN OF STORM SEWERS,

J. G. Hendrickson, and T. K. Breitfuss. Pub Works, Vol 87, No 2, pp 91-5, 1956.

Descriptors: Design, *Runoff forecasting, Rainfall intensity, *Storm runoff, Construction, *Intakes, *Outlets, *Manholes. Identifiers: *Storm sewers, *Capacity.

The calculation of run-off, which is dependent upon intensity, duration, and direction of rainstorms and slope and condition of surface of area to be served, is a very important factor in design of storm sewers. Storm run-off formulae and calculation of run-off are discussed. The authors consider also the design and construction of different types of inlets and outlets for storm sewers, design and location of manholes, and the load-carrying capacity of sewer pipes. W69-02178

STORM SEWER DESIGN BY THE INLET

METHOD, Albert B. Kaltenbach. Pub Works, Vol 94, Jan 1963.

Descriptors: *Design, *Intakes, *Storm drains, *Rainfall intensity, Hydrographs, Flow measure-

Identifiers: *Storm sewers.

The Inlet Method of Design for storm sewers was developed from a continuing research project on storm drains that has been carried on by the Johns Hopkins University for the past 13 years. The article reports this method has shown results closer to and more consistent with actual conditions than any other known design method. The 3 steps involved are (1) determination of peak flows to each inlet based on maximum 5 minute rainfall intensity; (2) attenuating the flow peak from sub-area as it moves down the pipe; and (3) summing each subarea hydrograph to determine the total hydrograph at the design point. A simplified procedure is given for the designs where many inlets are involved. W69-02179

LEAVES WON'T CLOG THIS CATCH BASIN, For primary bibliographic entry see Field 08A. For abstract, see . W69-02182

STORM SEWER ENDS MAN-MADE FLOODS, Alfred R. Pagan.

Amer City, Vol 78, p 87, Jan 1963.

Descriptors: *Storm runoff, Surface drainage. Identifiers: *Storm sewers, *Urban drainage.

The Borough of Palisades Park, N. J., part of the metropolitan New York complex, had a storm drainage problem. How this problem was solved is described. W69-02188

SPLIT LEVEL DESIGN FOR SEWER SEPARA-TION.

For primary bibliographic entry see Field 08A. For abstract, see . W69-02192

HIGHWAY DRAINAGE AND EROSION CON-

J. L. Sanborn.

Purdue Univ-Eng Extension Ser-Eng Bul 113, pp 68-73, 1963.

Descriptors: *Highways, *Drainage systems, Surface runoff, *Outlets. Identifiers: *Storm sewers.

Principles involved in controlling erosion and providing proper surface drainage are reviewed; how to build adequate transverse slopes and longitudinal grades on roadways, collecting ditches along roadside, and stable outlets to established water courses is discussed. W69-02193

GROUND WATER CONTROL FOR HIGHWAYS,

T. W. Smith.

Nat Res Council-Highway Res Bd-Res Rec, No 57, pp 35-52, 1964.

Descriptors: *Highways, *Groundwater, *Subsurface drainage, Design, Construction.

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A-Control of Water on the Surface

Subsurface drainage procedures used in design and construction of highways in California are described; application, construction, and effectiveness of stripping and blanketing with permeable material, stabilization trenches, horizontal drains, and other specialized measures used for subsurface water controls are discussed; particular consideration is given to characteristics of permeable material. W69-02197

PROGRESS TO DATE AND CURRENT WORKS AT GLENROTHES NEW TOWN,

G. A. Sutherland.

Instn Municipal Eng, J, Vol 94, pp 325-9, Oct 1967

Descriptors: *Surface drainage, *Storm drainage, Storms, Flood control, *Design, *Sewers, Runoff, *Discharge (Water), *Hydrograph, *Construction costs, *Rainfall intensity. Identifiers: *Storm sewers, *Urban drainage.

Glenrothes, the second new town in Scotland, designated under the New Towns Act of 1946, was designated to contain an area of 5,730 acres and a target population of 32,000. Shopping, educational, and housing provisions are briefly discussed. The complete system of foul and surface water catchments is gravity operated and it has not been necessary to resort to either pumping or tunneling to maintain the gravity system. Two catchments, one draining the northern portion of the town (3,550 acres) and one draining the southern por-(3,38) acres) are described. A once in ten-year storm which should produce bank-full condi-tions and flooding has been provided for by twenty acres of balancing pond capacity based on an average water depth of three ft. This provision is estimated to cost 60,000 pounds. Design considerations are discussed for foulwater sewers and for surtions are discussed for fourhater sewers and for surface water sewers. Foulwater runoff was based on a future water consumption of 50 gal/head/day. Trunk and development sewers within housing areas were designed for a peak flow of 6 D.W.F. A discharge rate of 7 cumins/acre was calculated for 1/3 of the area; the remaining 2/3 discharging at the state of Lewin (see The trunk area). the rate of 1 cumin/acre. The trunk surface sewer was designed by the Road Research Laboratory's Unit Hydrograph method for a once per year storm. This method showed an 8% saving in cost over the previously used design method (M.O.H. rainfall intensity curve). Subsidiary sewers were designed using the rational method and Bilham's once per year storm. Continuing rainfall observation is expected to establish a rainfall intensity curve for the area. W69-02199

SHORTCOMINGS AND POTENTIAL OF ZON-

For primary bibliographic entry see Field 04C. For abstract, see . W69-02200

EMPIRICAL MODEL FOR PREDICTING DRAINAGE SYSTEM PERFORMANCE, P. A. Taylor, and D. G. Watts. Am Soc Agric Engrs-Trans, Vol 10, No 6, pp 723-6, 729, Nov-Dec 1967.

Descriptors: *Drainage systems, *Design, Sewers, *Computer programs.

Effect of springtime weather patterns, soil physical factors, and drainage system geometry on optimum design drainage coefficient for sizing mains and submains was studied at Oregon Agricultural Experiment Station; study of Amity series is reported; development of computer programs for water table simulation. W69-02201

STORM DRAINAGE PROBLEMS AND SOLU-TIONS

A. L. Tholin. Pub Works, Vol 92, No 8, p 172, 1961. Descriptors: *Planning, Cities, *Storm drainage.

In a paper presented at a conference on environmental engineering and metropolitan planning the author outlined the problems encountered concerning the estimation and disposal of storm drainage and discussed how these problems could be solved W69-02202

FUNCTION AND ORGANIZA HIGHWAY DRAINAGE SECTIONS, ORGANIZATION OF

F. W. Thorstenson.

ASCE Proc, J Highway Div, Vol 91, No HW1, paper 4207, pp 49-54, Jan 1965.

Descriptors: *Highways, *Drainage, *Surface ru-

Identifiers: *Storm sewers.

Basic function of highway drainage sections, as related to design of culverts, bridge waterway openings, storm sewers, and erosion control facilities, is described; services pertaining to drainage matters that normally confront highway department organizational structure is suggested; procedures for conducting drainage activities. W69-02203

DESIGN OF STORM SEWER SYSTEMS.

For primary bibliographic entry see Field 02E. For abstract, see W69-02204

EFFECT OF USING CONTINUALLY SUB-MERGED DRAINS ON DRAIN SPACINGS,

J. Wesserling.
J Hydrology, Vol 2, No 1, pp 33-43, 1964.

Descriptors: *Storm drains, *Plastic pipes, Construction, Drainage systems.

Solution of flow problem given by Kirkham (1958) has been worked out for submerged drains; some calculation examples show that under certain favorable conditions considerable increase of drain spacing can be obtained by using deep, submerged drains; installing of such drainage systems is possible when using plastic pipes; carrying out drainage works under wet conditions, as will be often necessary, may in some soils impair structural stability of soil surrounding pipes; it should be investigated in what measure this will be the case when using modern laying methods. W69-02205

DRAIN THAT GREW AND GREW, For primary bibliographic entry see Field 08A. For abstract, see . W69-02206

SOIL AND WATER PROBLEMS ON BUILDING SITES.

For primary bibliographic entry see Field 08A. For abstract, see W69-02207

GRAPHIC STORM SEWER DESIGN.

For primary bibliographic entry see Field 08A. For abstract, see . W69-02208

POLLUTION OF STORM RUNOFF IN THE DRAINAGE SYSTEM OF LARGE TOWNS, G. Schigorin.

Vodosn Sanit Tech, Vol 2, pp 19-20, 1956.

Descriptors: *Water pollution, *Storm runoff, Rainfall intensity, *Biochemical oxygen demand, *Storm drainage, *Cities. Identifiers: *Urban drainage, *Leningrad (Russia), *Storm drainage, *Company drainage, *Leningrad (Russia), *Storm drainage, *Company draina

*Suspended solids.

The author describes investigations into the condition of storm water flowing from the street drainage system of a district of Leningrad. The effect of rainfall of various duration and intensity on different types of streets is discussed and a table of maximum, minimum, and mean values for contents of suspended and volatile matter, oxygen demand, BOD in 5 and 20 days is given. W69-02209

POLLUTION OF CITY SURFACE RUN-OFF

For primary bibliographic entry see Field 05B. For abstract, see . W69-02210

EFFECTIVENESS OF THE INTERCEPTION OF SEWAGE-STORM WATER MIXTURES,

Walter G. Shifrin.

U of Missouri Bull, Eng Series Bull No 47, Vol 61, No 8, pp 8-12, Feb 12, 1960.

Descriptors: *Storm runoff, *Overflow, Water pollution control

Identifiers: *Combined sewers, Calculations, *Interceptor sewers, *Capacity, *St. Louis (Mo.).

Since it is not economically feasible to intercept and treat all of sewage-storm water runoff mixture, the study reports on determination of proper interception factor. Average daily sewage flow was converted to an equivalent rainfall of 0.007 in/hr/acre for the area drained by combined sewers. Peak sewage rate was taken as 136% of average or 0.0095 in/hr/acre. Graphs and charts show the author's derivation of number of hours per year sewage would be bypassed. Author's conclusions based on specific case of St. Louis with overflows going to Mississippi River are that selection of interceptor capacities in excess of peak dry weather flow rate will produce an insignificantly small increase in the effectiveness of pollution abatement at a significant increase in the initial cost of the facilities. W69-02211

SEWAGE DISPOSAL IN THE REGION OF THE LOWER LAKE THUN,

For primary bibliographic entry see Field 05C. For abstract, see . W69-02213

STORM-WATER OVERFLOWS,

R. B. Stegmaier. Sewage Works J, Vol 14, p 1264, 1942.

Descriptors: *Storm runoff, *Overflow, Flow measurement.

Identifiers: *Combined sewers, Baltimore (Md.), *Suspended solids.

Studies were made of the storm water discharged from a combined sewer in Baltimore, Md., during six storms. The maximum amounts of volatile solids and of total solids occurred at the maximum rate of flow. W69-02214

RELATIONS BETWEEN THE DEGREES OF DILUTION IN THE SEWERS AT THE STORM WATER OUTLET, AND IN THE RECEIVING STREAM,

. Vomberg

Gesundheits-Ing, Vol 74, pp 227-9, 1953.

Descriptors: *Design, *Storm runoff, *Overflow, Identifiers: *Calculations, Dilution.

The author discusses the calculations required in the design of storm water overflows and in the determination of their effect on the receiving stream. W69-02220

WATER QUANTITY MANAGEMENT AND CONTROL-Field 04

Control of Water on the Surface—Group 4A

STORM SEWAGE OVERFLOWS - A MAJOR POLLUTION SOURCE.

For primary bibliographic entry see Field 05B. For abstract, see . W69-02221

URBAN DRAINAGE AS A FACTOR IN EUTROPHICATION,

Federal Water Pollution Control Admin., Cincin-

For primary bibliographic entry see Field 05C. For abstract, see .

W69-02222

URBAN LAND RUN-OFF AS A FACTOR IN STREAM POLLUTION, For primary bibliographic entry see Field 05B.

For abstract, see . W69-02223

CHARACTERIZATION, TREATMENT AND DISPOSAL OF URBAN STORM WATER, For primary bibliographic entry see Field 05B.

For abstract, see . W69-02224

PESTICIDES AND OTHER CONTAMINANTS IN RAINFALL AND RUNOFF,

For primary bibliographic entry see Field 05B. For abstract, see . W69-02225

QUALITY OF RAINFALL RUN-OFF WATER FROM A HOUSING ESTATE,

For primary bibliographic entry see Field 05B. For abstract, see . W69-02226

STORAGE ROUTING METHODS OF FLOOD ESTIMATION,

E. M. Laurenson

Instn Engr, Australia-Civ Eng Trans, Vol Ce 7, No 1, pp 39-47, April 1965.

Descriptors: *Flood forecasting, *Model studies, *Rainfall-runoff relationships.

Estimation of floods resulting from rain storms on catchment areas by means of routing rainfall-excess through computational model representing catchment storage is discussed; main methods and concepts necessary to understanding and use of new storage routing technique are reviewed; several concepts are illustrated in example of application.

W69-02243

A CATCHMENT STORAGE MODEL FOR RUN-OFF ROUTING, E. M. Laurenson. J Hydrol, Vol 2, pp 141-163, 1964.

Descriptors: *Surface runoff, *Rainfall-runoff relationships, *Model studies, Discharge (Water), *Hydrographs, Storms.

To determine the surface run-off resulting from developed by dividing the area into sections of equal storage delay time. Run-off was routed through the catchment by taking the outflow from a section plus the rainfall-excess as the inflow to the next section. The average delay time was shown to be equal to the lag for a catchment, and an empirical relation was determined between the lag and the mean discharge for a particular flood. The procedure was applied to storm data recorded at the University of New South Wales, South Creek experimental catchment, and the results were compared graphically with actual surface run-off hydrographs. Satisfactory agreement was obtained except in cases where the hydrograph rise was small. W69-02244

STUDY OF R R L HYDROGRAPH METHOD OF DESIGNING SEWER SYSTEMS,

For primary bibliographic entry see Field 07C. For abstract, see . W69-02250

ON THE IMPORTANCE OF VOLUME DISTRIBUTION IN THE CALCULATION OF DRAINAGE SYSTEMS,

P. H. Rendsvig.

Gesundheits-Ing, Vol 84, pp 241-246, 1963.

Descriptors: *Drainage systems, *Runoff forecast-

Identifiers: *Calculations.

The author discusses a graphical method for calculating the volume of run-off to be allowed for in sewerage systems. He compares his result, based on the summation equation, with the Schoenefeldt method. W69-02254

NOTES ON CALCULATING FLOW OF SUR-FACE WATER IN SEWERS,

D. W. Riley.

J Instn Munic and County Engrs, Vol 58, No 20, pp 1483-94, March 29, 1932.

Descriptors: *Surface runoff, Rainfall intensity,

Identifiers: *Calculations.

Methods of computing runoff corresponding to various rainfalls; intensity-duration and area-time

ANALYTICAL CALCULATION OF STORM-WATER FLOWS IN A LARGE CHANNEL

G. Supino.

Wasserwirtschaft, Stuttgart, Vol 52, pp 122-126, 1962

Descriptors: *Storm runoff. Identifiers: *Calculations, Italy.

The author summarizes methods developed in Italy for the calculation of storm-water run-off. These can be applied to canals, sewerage systems, and natural watercourses. The various equations and their range of application are discussed. W69-02271

PROGRESS REPORT ON THE STORM DRAINAGE RESEARCH PROJECT, JULY 1ST, 1959 TO JUNE 30TH, 1960,

W. Viessman.

Johns Hopkins Univ, Dept Sanit Eng Water Resour, Baltimore, 1960.

*Storm drainage, *Discharge (Water), *Runoff forecasting, *Rain-fall intensity, Weirs, Rain gage, Flow measurement, *Storm runoff, Intakes, *Design. Identifiers: *Baltimore (Md.), *Urban drainage.

Progress in the storm drainage research project at Baltimore, Md. (see Wat. Pollut. Abstr. 1960, 33, Abstr. No. 2011) is reported, including studies on the effect of slope on the peak discharge from small drainage areas, the effect of antecedent rainfall on the peak rate of run-off, and the relation between the maximum 5-minute rainfall intensity and the duration of the intense part of a storm; the analysis of rainfall and run-off data for the gauged inlet areas; the development of a standard weir for use in hydrological research. It is hoped that the analysis of data from the existing and proposed gauging stations will ultimately permit the development of a satisfactory procedure for predicting flows to storm-water inlets and designing the appropriate drainage system. W69-02276

MAD RIVER, HUMBOLDT AND TRINITY COUNTIES, CALIFORNIA.

Corps of Engineers, Washington, D. C. For primary bibliographic entry see Field 08A. For abstract, see . W69-02280

LOWER CHARLES RIVER WATERSHED, MASSACHUSETTS.

Corps of Engineers, Washington, D. C. For primary bibliographic entry see Field 08A. For abstract, see. W69-02281

PAPILLION CREEK AND TRIBUTARIES, NEBRASKA.

Corps of Engineers, Washington, D. C. For primary bibliographic entry see Field 08A. For abstract, see . W69-02282

BEAR CREEK BASIN, SOUTH PLATTE RIVER AND TRIBUTARIES, COLORADO, WYOMING, AND NEBRASKA.

Corps of Engineers, Washington, D. C. For primary bibliographic entry see Field 08A. For abstract, see . W69-02283

COLORADO RIVER AND TRIBUTARIES, TEXAS, COVERING MOUTH OF COLORADO RIVER.

Corps. of Engineers, Washington, D. C. For primary bibliographic entry see Field 08A. For abstract, see . W69-02292

WILD RICE RIVER, MINNESOTA.

Corps. of Engineers, Washington, D. C. For primary bibliographic entry see Field 08A. For abstract, see . W69-02297

PECAN BAYOU, TEXAS.

Corps. of Engineers, Washington, D. C. For primary bibliographic entry see Field 08A. For abstract, see W69-02298

PUBLIC WORKS AUTHORIZATIONS, 1968 RIVERS AND HARBORS - FLOOD CONTROL AND MULTIPLE PURPOSE PROJECTS - PART

Hearings before the Subcommittee on Flood Control - Rivers and Harbors of the Committee on Public Works, U S Senate 90th Congress, 2nd Session May 14, 15, 16, 21, 22, and 23, 1968.

Legislation, *Florida, *Water resources, Water conservation, Water distribution, Canals, Levees, *Alabama, Floods, *Kentucky, Ohio River, Reservoir sites, Project planning. Identifiers: Everglades National Park.

The reports on Florida projects continued. The next report considered water resources for central and southern Florida. The drought of 1961 to 1965 demonstrated the need for improving water conservation for urban and agricultural needs and for preserving the Everglades National Park. The recommended plan calls for modification of the authorized water resources project by (1) raising Lake Okeechobee levees, (2) back pumping excess waters from east coast areas, and (3) improving water distribution by constructing and modifying canals, levees, pumping stations, control structures and related works. The next report on the Alabama-Coosa River Basin revealed that the area was subject to periodic flooding. The recom-mended plan entails constructing a levee system, pumping plant and drainage structures for Selma and Selmont, Alabama. The report on Southwest

Field 04-WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A-Control of Water on the Surface

Jefferson County, Kentucky, indicated a flood problem caused by the Ohio River. The recommended plan calls for an earth levee along the Ohio River together with interior drainage facilities. The report on the Licking River Basin, Kentucky, indicated a lack of flood-free land suitable for economic growth. The recommended plan calls for: (1) Royalton Reservoir; (2) two channel improvements; (3) three flood retardation structures; and (4) land treatment measures. (Childs-Fla) W69-02299

WATER-SUPPLY STRINGENCIES--FEATURES, ANTECEDENTS AND OBSTACLES RESOLUTION.

U. S. Geological Survey

For primary bibliographic entry see Field 06E. For abstract, see

W69-02330

TRENDS IN RESERVOIR CAPACITY AND USE.

U. S. Geological Survey, Washington, D. C For primary bibliographic entry see Field 03B. For abstract, see . W69-02336

EFFECTS OF CYCLONE BEULAH ON THE YU-CATAN PENINSULA (SPANISH),

For primary bibliographic entry see Field 02E For abstract, see . W69-02359

END OF CYCLONE BEULAH, MEXICO (SPANISH),

For primary bibliographic entry see Field 02E. For abstract, see W69-02364

4B. Groundwater Management

BEHRENS V SCHARRINGHAUSEN (REASONA-BLE USE OF PERCOLATING WATERS).

For primary bibliographic entry see Field 06E For abstract, see . W69-02004

GROUND WATER RECHARGE - CONSERVA-TION IN NASSAU COUNTY, W. Fred Welsch

J Amer Water Works Assn, Vol 52, p 12, 1960.

Descriptors: *Storm runoff, *Groundwater, Outlets, *Drainage, *Stilling basins, Chemical analysis. Identifiers: *Surface permeability.

Ground water replenishment with storm water serves several purposes: (1) replenish ground water supply, (2) provide drainage outlets without long conduits, and (3) reduce size of conduits for storm water drainage. Recharging done in several ways: (1) for small areas large dia. diffusion pipe installed in caisso. fashion, (2) single basin recharge reservoirs, and (3) two unit basins, first one to act as settling basin and second as seepage or percolation basin. Designed on a 5 in. rainfall in 2 days which has a frequency of about 5 years. Runoff coefficients increasing as area develops and pervious area decreases. Seepage rates for area are approximately 24 gpd/sq ft or 1 mgd/acre. Analyses of storm water basins indicate chlorides of 2.4 ppm, iron 0.1 - 0.8 ppm and D.C. of 132 - 218 ppm. Phenols have been found where runoff is from pavements of bituminous tar material. W69-02241

4C. Effects on Water OF Man's Non-Water Activities

PRESUMPTION OF GRANT OF ALL IN-TEREST.

La. Rev Stat Sec 9:2971 (Supp 1968).

Descriptors: *Louisiana, *Legislation, Contracts, Waterway, Canals, Highways, *Right of way, Railroads, Land tenure, Leases.

Any transfer or other contract affecting land fronting on a waterway, canal, road, or other right of way is conclusively held under this act to include all of the grantor's interest in and under such right of way in the absence of an express provision to the contrary. Where the grantor owns title to the fee of land on both sides of the right of way and grants the land on only one side, it shall be conclusively presumed that all the grantor's interest to the center has been granted in the absence of a contrary provision. No existing valid rights are affected by this act. (Childs-Fla) W69-02039

SHORTCOMINGS AND POTENTIAL OF ZON-ING, Lee Anthony Syracuse

ASCE Proc, J Urban Planning Devel Div, Vol 93, No UP4, pp 53-62, Dec 1967.

Descriptors: *Highways, *Storm drains, Surface ru-Identifiers: *Storm sewers.

Broad aspects of zoning are discussed. A brief discussion of storm sewers in cul-de-sac easement lanes is included. Inverted crown roads or onesided sewer installation with the street slightly slanted toward the sewer can be used. W69-02200

FUNCTION AND ORGANIZA HIGHWAY DRAINAGE SECTIONS. **ORGANIZATION** For primary bibliographic entry see Field 04A. For abstract, see

W69-02203

SOIL AND WATER PROBLEMS ON BUILDING SITES.

For primary bibliographic entry see Field 08A. For abstract, see W69-02207

EFFECTS ON WINTER STORM RUNOFF ON **VEGETATION AND AS A FACTOR IN STREAM** POLLUTION.

Richard H. Sullivan

7th Annual Snow Conf, Milwaukee, Wis, April 12,

Descriptors: *Chemical analysis, *Storm runoff,

A determination of chloride content of storm water discharge from a section of the Kennedy Expressway in Chicago during the winter of 1966-7 carried out. Methods and results are given. Salt from snow clearing operations can cause occassional high salt concentrations. Results of tests on storm water from an area in which Cargill's Carguard was used as a corrosion inhibitor are given. Other studies on the effect of chlorides on vegetation are discussed. W69-02216

EFFECTS OF CONSTRUCTION ON FLUVIAL SEDIMENT, URBAN AND SURBURBAN AREAS OF MARYLAND,

M. G. Wolman, and A. P. Schick. Water Resour Res, Vol 3, pp 451-464, 1967.

Descriptors: *Water pollution, *Storm runoff, *Sedimentation, Estuaries, *Recreational facilities. Identifiers: *Urban drainage.

The problem of sediment pollution by run-off from building sites in Maryland is discussed. Sediment yields ranging from 140,000 tons per square mile per year on an open construction site to 1060 tons in an urban area with some development were found. The quantity of sediment from areas under construction is 2-200 times as great as that derived from comparable rural or wooded areas. Details of changes in the stream bed of Oregon Branch caused by sediment from a construction site are given and compared with an unpolluted reach of the stream. Costs arising from sediment pollution of reservoirs, estuaries and channels are discussed and the loss of recreational facilities is mentioned. Measures to control sediment pollution are suggested. W69-02227

4D. Watershed Protection

COLLECTION AND PAYMENT OF ASSESS-EXPENDITURE OF PROCEEDS MENTS: THEREOF AND OTHER DISTRICT FUNDS.

N C Gen Stat Sec 139-27 (1967).

Descriptors: *North Carolina, Legislation, *Administrative agencies, *Taxes, *Assessments, Costs, Government finance, Water resources development, Local governments.

Under Sec 139-27, an assessment against a landowner for a watershed improvement district may be paid in its entirety, upon election, and in the absence of such election, the landowner will be deemed to have elected payment by annual installments. Provisions are made for such annual install-Receipts and specified collection procedures are required. Receipts are to be sent to the taxpayers. Watershed assessments are to be collected by the county tax collector, and paid over to the watershed improvement district. A limitation period is specified and all proceedings for watershed assessments are to be considered in rem. A form for the assessment receipts is provided. (Williams-Fla) W69-02027

05. WATER QUALITY MANAGEMENT AND **PROTECTION**

5A. Identification **OF Pollutants**

HOW TO ANALYZE COMBINED SEWAGE-STORMWATER COLLECTION SYSTEMS,

R. H. Stanley. Water and Wastes Eng, Vol 3, No 3, pp 58-61, March 1966 and pp 48-50, April 1966.

Descriptors: *Hydraulics, *Biochemical oxygen demand. Rain. *Storm runoff, *Overflow, *Water pollution, Drainage, Computer programs. Identifiers: *Calculations, *Combined sewers

Method of analysis proposed involves field measurement of system hydraulic characteristics and condition; using these hydraulic characteristics and past records of BOD levels and rainfall, overflow quantity and pollution contribution may be calculated; proposed method is adaptable to analysis of system or drainage area changes; it can be performed economically and in relatively short period of time; calculations involved can be handled by means of digital computer. W69-02159

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Sources of Pollution—Group 5B

OBSERVATIONS ON DREDGING AND DIS-SOLVED OXYGEN IN A TIDAL WATERWAY, Navy Underwater Sound Laboratory, Ocean Sciences Division, New London, Connecticut, and Cornell Univ., Ithaca, New York

Charles L. Brown, and Robert Clark.

Water Resources Res, Vol 4, No 6, pp 1381-1384, December 1968. 4 p, 2 fig, 4 ref.

Descriptors: *Water pollution sources, *Dredging, *Bottom sediments, *Dissolved oxygen, Suspension, Turbidity.

Study of dissolved oxygen in Arthur Kill and Kill van Kull, Staten Island, New York, during dredging showed that resuspension of oxidizable bottom sediments caused DO reductions of 16-83%. The net seaward movement of water in the streams is very slow. Water remains in the same area about a week and is affected by 2 daily tidal cycles. Wastes are discharged into it at a steady rate; the decrease in DO is caused by resuspension of mud. Dissolved oxygen and secchi disc transparency data are presented in graphs. (Knapp-USGS) W69-02363

5B. Sources of Pollution

RUTH V AURORA SANITARY DIST (POLLU-TION ABATEMENT). 158 N E 2d 601-608 (111 1959).

Descriptors: *Illinois, Judicial decisions, Districts, Municipal wastes, Sanitary engineering, Water pollution, Sources, Disposal, Sewage treatment, *Nuisance (Water law), Sewage effluents, Public health, *Abatement, *Pollution abatement, Water pollution control.

Defendant was discharging untreated or in-adequately treated sewage into the river. Plaintiff, a residential subdivision developer was denied permission to connect his subdivision to the sewer system on the ground that it was already operating beyond its capacity, and that increased sewage waste would violate existing rules of public health. Plaintiff sued for abatement of nuisance by establishment of improvements in the collection system and disposal plant. The court held that the abatement of a public nuisance at the suit of an individual to whom the nuisance causes a particular injury was a valid exercise of its jurisdiction, and that the pollution of a river in the above manner is such a nuisance. The selection of the particular method by which this must be done was left to the defendant's discretion. (Scott-Fla) W69-02002

POWER OF CORPORATE AUTHORITIES TO PROHIBIT THROWING INTO RIVERS AND HARBORS SUBSTANCES DANGEROUS TO NAVIGATION OR TO PROPERTY; VIOLA-TION OF PROHIBITION AGAINST THROW-ING DANGEROUS OR INJURIOUS SUB-STANCES INTO SAVANNAH RIVER. Ga Code Ann Secs 80-1268 and 80-9902 (1967).

Descriptors: *Georgia, Local governments, *Cities, *Navigable waters, Legislation, *Water pollution.

Sec 80-126 authorizes the mayor and aldermen of Savannah to prohibit under proper penalties the throwing or depositing in the Savannah River, or within the harbor limits, of any substance which they might consider dangerous to navigation or injurious to vessels or the property abutting the har-bor. Equal powers are vested in the corporate authorities of other Georgia towns and cities with regard to navigable waters within their jurisdiction. Sec 80-9902 makes the master of any vessel from which a substance forbidden under Sec 80-126 is thrown into the Savannah River guilty of a misdemeanor. (Williams-Fla) W69-02062

COMBINED SEWER OVERFLOWS, Carlysle Pemberton.

Water Resources Engng Conf, ASCE, Milwaukee, Wis, May 13-17, 1963, 20 p, 2 fig, 14 ref.

Descriptors: *Overflow, Flow measurement, *Water pollution, *Biochemical oxygen demand, Descriptors: Storm runoff.

Identifiers: *Combined sewers, *Suspended solids, Chicago (III).

A study was made of flow rates and composition of overflows from a large combined sewer serving a residential area of 8.6 square miles with a population of 144,300. Overflows occurred during 1.7 per cent of the time, in a 14-month period when rainfall was about 75 percent of normal. Gross bacterial pollution was discharged during overflows, limiting the use of the receiving waters from a public health standpoint. Suspended solids concentration in the overflow was greater on the average than that of dry weather flow, with considerable variation associated with rainfall intensity and time since the last storm. The 5-day BOD concentration in the overflow averaged about one-half that of dry weather flow, and was found to decrease with time after overflow started. The total BOD load discharged during overflows was 2.5 times the dry weather BOD load for the same number of hours. By extension of the observed data, it is estimated that the BOD load resulting from combined sewer overflows accounts for about 19 per cent of the total BOD load in the canal system serving the Chicago area W69-02147

EFFECT OF STORM WATER ON THE SEWERAGE SYSTEM AND THE RECEIVING STREAMS.

For primary bibliographic entry see Field 04A. For abstract, see. W69-02153

EXTENSIVE SEWERAGE WILL CURB POLLU-TION OF A BAY,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02154

THE STORM-WATER COMPROMISE, For primary bibliographic entry see Field 04A.

For abstract, see . W69-02155

IMPROVING THE EFFICIENCY OF EXISTING INTERCEPTORS.

For primary bibliographic entry see Field 04A. For abstract, see. W69-02156

BRIEF HISTORY OF POLLUTION PROBLEMS AND POLLUTION CONTROL IN THE CITY OF LONDON, ONT, C. C. Rutherford.

Water Poll Control, Ont, Vol 105, No 5, pp 66-69, 71, 1967.

Descriptors: *Water pollution, *Storm runoff, *Overflow, Water pollution control. Identifiers: *Combined sewers, Urban drainage.

An historical description is given of pollution problems and control measures in London, Ont., which by the late 1950's was served by 3 overloaded sewage works. Problems included gross pollution of the Thames River by overflows from combined sewers, run-off from septic-tank areas, and flows from industrial sources. Subsequent annexation led to the acquisition of 3 more works; one of the original plants has been closed down and the others have been expanded and modernized. In addition, an industrial waste control programme has been begun, and pollution of the river has been considerably reduced. W69-02157

DIVERSION FACTORS FOR COMBINED SEWERS BASED ON SEWAGE AND STREAM

For primary bibliographic entry see Field 04A For abstract, see W69-02160

COMBINED VS SEPARATE SYSTEMS OF SEWERAGE,

A. R. Ward.

Survr, Vol 81, No 2093, pp 299-300, March 4,

Descriptors: *Storm runoff, *Water pollution, Pumping, Sewers, *Deposition (Sediments). Identifiers: *Combined sewers.

Discussion of sewerage systems; river pollution by storm water; deposition of solids in main sewers; combined system; pumping. W69-02163

STORM WATER IN SANITARY SEWERS. For primary bibliographic entry see Field 04A.

For abstract, see. W69-02175

ARE PROTECTED STORM WATER OUTLETS DANGEROUS TO STREAMS,

W. Passavant Gesundheits-Ing, Vol 75, pp 362-3, 1954.

Descriptors: *Water pollution, Storm runoff, *Outlets, Equipment. Identifiers: *Storm sewers.

The author gives a brief survey of possible methods for reducing pollution by storm water with special reference to the use of centrifugal screens. W69-02189

POLLUTION OF STORM RUNOFF IN THE DRAINAGE SYSTEM OF LARGE TOWNS, For primary bibliographic entry see Field 04A. For abstract, see . W69-02209

POLLUTION OF CITY SURFACE RUN-OFF WATER,

G. G. Schigorin. Vodosn Sanit Tekh, No 2, pp 19-20, 1956.

Descriptors: *Water pollution, *Storm runoff, *Cities, Rainfall intensity, *Storm drainage. Identifiers: *Storm sewers, Suspended solids, *Russia. Urban drainage.

To study the polluting effect of run-off from paved areas, samples of storm water collected from the separate storm-water sewers in Vasileostrovsk, U.S.S.R., and of water from street rain receivers after paved streets had been washed with automatic sprinklers, were analysed; the results are tabulated. Marked fluctuations in the concentrations of suspended solids are attributed to the differing degrees of dirtiness of different streets. Heavy rain did not appear to reduce the polluting effect of later run-off, probably because pollution intensities at the points of origin (road sweepings, products of breakdown of pavements, and air-borne contaminants) were relatively constant. Surface run-off from cobbled streets with comparatively light traffic was much less polluting than run-off from asphalt-paved streets with heavy traffic. The need for preliminary treatment of such run-off to reduce pollution of the receiving streams is stressed. W69-02210

EFFECTIVENESS OF THE INTERCEPTION OF SEWAGE--STORM WATER MIXTURES, For primary bibliographic entry see Field 04A. For abstract, see . W69-02211

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B-Sources of Pollution

SEASONAL VARIATIONS IN SURVIVAL OF INDICATOR BACTERIA IN SOIL AND THEIR CONTRIBUTION TO STORM-WATER POLLU-TION.

Dale J. Van Donsel, Edwin E. Geldreich, and Norman A. Clark

Appl Microbiol, pp 1362-1370, Nov 1967. 4 fig, 27

*Bioindicators, *Storm runoff, *Water pollution, *Coliforms. Identifiers: *Bacteriological sampling.

Survival of a fecal coliform (Escherichia coli) and a fecal streptococcus (Streptococcus faecalis var. liquifaciens) was studied through several years at shaded and exposed outdoor soil plots. Death rates for both organisms were calculated for the different seasons at both sites. The 90% reduction times for the fecal coliform ranged from 3.3 days in summer to 13.4 days in autumn. For the fecal streptococcus, 90% reduction times were from 2.7 days in summer to 20.1 days in winter. During summer, the fecal coliform survived slightly longer than the fecal streptococcus; during autumn, survival was the same; and in spring and winter the fecal streptococcus survived much longer than the fecal coliform. Both organisms were isolated from stormwater runoff collected below a sampling site when counts were sufficiently high in soil. Isolation was more frequent during prolonged rains, lasting up to 10 days, than during short rain storms. There was evidence of aftergrowth of nonfecal coliforms in the soil as a result of temperature and rainfall variations. Such aftergrowth may contribute to varia-tions in bacterial count of storm-water runoff which have no relation to the sanitary history of the drainage area. W69-02218

A STUDY OF LAKE MICHIGAN: CHEMICAL, BIOLOGICAL, AND PHYSICAL.

J. L. Verber.

Verh Int Verein Theor Angew Limnol, 1965, Vol 16, pp 29-46, 1966.

Descriptors: *Water pollution control, *Overflow, *Storm runoff, Chemical analysis Identifiers: Oil pollution, *Lake Michigan.

Comprehensive investigations were made to determine the present water quality in Lake Michigan and make recommendations for its preservation; some of the physico-chemical, bacteriological, and biological results are presented in tables and diagrams and discussed. Sufficient vertical mixing occurs during spring and autumn to distribute the chemical constituents uniformly throughout the water column. It is concluded that the lake is still oligotrophic but precautions must be taken to reduce the build-up of phosphates and nitrates in certain areas where municipal and trade waste waters are discharged, particularly in the southern basin where there appears to be a large semipermanent clockwise gyral which tends to prevent dispersal of nutrients from the basin into the rest of the lake; chemical and biological differences between the northern and southern basins also indicate that horizontal mixing is very slow. The zone of poor-quality water along the coast near waste outfalls varies in width depending on the meteorological conditions. Preliminary action has been taken to reduce pollution, especially that caused by storm-sewage overflows and by oily, phenolic, and other trade waste waters. W69-02219

STORM SEWAGE OVERFLOWS - A MAJOR POLLUTION SOURCE, K. H. Walker.

Wastes Eng, Vol 33, No 8, Aug, 1962.

Descriptors: *Storm runoff, *Overflow, *Water Identifiers: *Combined sewers, Boston (Mass), New York (NY).

This editorial stresses the need for further study and data to aid in solving the problem of storm sewage overflow. 1946 studies using Boston rainfall records show that sewage systems designed to handle 2 to 3 times average dwf would overflow 5-6 days/mo. The study also showed that with rainfalls of 0.20 inches/hr., nearly 90% of sanitary sewage would be discharged untreated. A New York City study showed that 60 to 80% of the raw sewage flowing through combined systems is discharged into the receiving waters once or twice a week. W69-02221

URBAN LAND RUN-OFF AS A FACTOR IN STREAM POLLUTION,

S. R. Weibel, R. J. Anderson, and R. L. Woodward.

J Water Poll Control Fed, Vol 36, pp 914-924,

Descriptors: *Water pollution, *Storm runoff, *Biochemical oxygen demand, *Turbidity, Chemical analysis, *Pathogenic bacteria, *Coliforms.
Identifiers: *Urban drainage, *Suspended solids, Surface permeability.

After reviewing briefly the work of other investigators on the composition and strength of run-off from urban areas, the authors describe a study carried out in part of Cincinnati, where about 37 per cent of the total drainage area is impermeable, the remainder being lawns, parks and gardens. The run-off had an average B.O.D. of 19 mg per litre, a chemical oxygen demand of 99 mg per litre, a suspended-solids content of 210 mg per litre, a turbidity of 170 units and a colour of 81 units. The run-off was also found to contain organic chlorides, which could be derived from pesticides, and large numbers of bacteria, although faecal streptococci exceeded faecal coliform organisms, indicating predominantly non-human pollution. The highest concentrations of all contaminants occurred within the first 15 min of the start of run-off. These results confirm that run-off should be taken into consideration when estimating waste loadings from urban sources, and the authors stress the need for further studies to estimate the strength of run-off under various conditions. W69-02223

CHARACTERIZATION, TREATMENT DISPOSAL OF URBAN STORM WATER, TREATMENT AND S. R. Weibel, R. B. Weidner, and A. G Christianson

Proc 3rd Int Conf Water Poll Res, Munich, 1966, Vol 1, pp 329-352, 1967.

Descriptors: *Water pollution, *Storm runoff, *Chemical analysis, Rain, *Coliforms, Recreation facilities, *Sewage treatment, Chlorination, *Biochemical oxygen demand, Sedimentation, *Groundwater recharge.
Identifiers: *Urban drainage, *Suspended solids,

Long Island (NY).

The authors give further results of studies at Cincinnati, Ohio, on the polluting effect of run-off from urban areas, including investigations of the chemical composition of the rain falling on the study area. The rain water was found to contain, on average, 0.69 mg of inorganic nitrogen and 0.24 mg of hydrolysable phosphate, per litre; these concentrations exceed the threshold values found by other workers for the development of algal blooms. The rain water also contained about 0.28 microgram of organic chlorine compounds per litre; DDT, DDE, benzene hexachloride were identified. Analyses of the run-off, as reported previously, showed its pollution potential, and the concentrations of coliform organisms exceeded the criterion of 1000 per 100 ml recommended for bathing waters. Preliminary laboratory experiments on treatment of the run-off showed that sedimentation alone was not effective in reducing the BOD and suspended-solids content. Sedimentation for 20 min combined with chlorination at a dose of 4.62 mg of chlorine per litre killed more than 99 per

cent of the bacteria; when the supernatant liquor was dechlorinated, however, and kept at room temperature for 24-72 hours, there was aftergrowth of coliform organisms, though not of faecal coliform bacteria or faecal streptococci. This work is still being continued. On Long Island, N. Y., storm runoff is being disposed of successfully by infiltration through the sandy sub-soil to recharge the groundwater resources in the area. W69-02224

PESTICIDES AND OTHER CONTAMINANTS IN RAINFALL AND RUNOFF, S. R. Weibel, R. B. Weidner, and J. M. Cohen.

AWWA J, Vol 58, No 8, pp 1075-84, Aug 1966.

Descriptors: *Storm runoff, Sampling, *Water pollution, Data collections. Identifiers: *Urban drainage.

Data on rainwater and rural runoff and updated statistics on urban runoff are presented; rainfall sampling was done in connection with urban stormwater-runoff studies, by Cincinnati Water Research Laboratory; results of rainfall analyses on pesticides are discussed; subsequent to collection and analysis of rainfall samples reported, it was found that some materials adhered to stainless steel trays; these materials can be removed by scrubbing with nonphosphate soap and solvent. W69-02225

THE QUALITY OF RAINFALL RUN-OFF WATER FROM A HOUSING ESTATE, R. Wilkinson.

J Inst Pub Health Engr.

Descriptors: *Design, *Rainfall intensity, Water pollution, Overflow, Storm runoff. Identifiers: *Storm sewers, *Urban drainage.

Housing estate of 611 acres, housing density of 5 to 6 houses per acre, est. population of 12,500, separate sewage system with storm system designed on 3/4 in/hr and impervious area of .4. Rain included 131 storms over year period with greatest rain 0.84 in/24 hr. period and most rains of small intensity. Statement made that first flush more polluting than rest of storm, but that certain storms continued stronger than some of the first flushes of other storms. Catchment basin washed clean by first flow of water. W69-02226

EFFECTS OF CONSTRUCTION ON FLUVIAL SEDIMENT, URBAN AND SURBURBAN AREAS OF MARYLAND,

For primary bibliographic entry see Field 04C. For abstract, see W69-02227

REMOTE SENSING OF WATER POLLUTION, Sacramento State College, Sacramento, California. For primary bibliographic entry see Field 07B. For abstract, see . W69-02285

POLLUTION AFFECTING RIPARIAN RIGHTS IN DEFINED CHANNELS OR DEPRESSIONS ON THE SURFACE OF THE GROUND, For primary bibliographic entry see Field 06E. For abstract, see . W69-02315

POLLUTION AFFECTING APPROPRIATIVE RIGHTS IN DEFINED CHANNELS OR DEPRESSIONS ON THE SURFACE OF THE GROUND, For primary bibliographic entry see Field 06E. For abstract, see. W69-02316

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Sources of Pollution—Group 5B

POLLUTION OF WATER IN DEFINED CHAN-NELS OR DEPRESSIONS ON THE SURFACE OF THE GROUND UNDER COMBINED RIPARIAN-APPROPRIATIVE SYSTEMS, For primary bibliographic entry see Field 06E.

For abstract, see . W69-02317

POLLUTION OF WATERS UNDER THE SUR-FACE OF THE GROUND,

For primary bibliographic entry see Field 06E. For abstract, see . W69-02318

POLLUTION OF WATER ON THE SURFACE OF THE GROUND BUT NOT IN DEFINED CHANNELS OR DEPRESSIONS,

For primary bibliographic entry see Field 06E. For abstract, see . W69-02319

PROTECTIVE MEASURES AND THE TORREY CANYON,

New Mexico Univ. A. E. Utton.

Boston College Ind and Com L Rev, Vol 9, No 3, pp 613-632, Spring 1968. 20 p, 99 ref.

Descriptors: *Oily water, Oil wastes, Water pollution, Water pollution sources, *International law, *International waters, Water pollution control, Oil,

Oil industry, Beaches, Aquatic animals.
Identifiers: Contiguous zones, Territorial waters.

The article examines what actions may be taken by a nation to protect itself from oil pollution damage caused by tanker accidents such as the Torrey Canyon incident of 1967. There is general agreement that a state may take unilateral action within a 'contiguous zone' outside its territorial waters under some circumstances. The 1958 Geneva Convention on the Territorial Sea and the Contiguous Zone fixed the zone at 12 miles and severely limited the situations in which action might be taken. Measures to curb oil pollution in the Torrey Canyon incident were probably properly taken under standards allowing the prevention of infringement of sanitary regulation. It is submitted that the state may exercise whatever control is 'necessary' to precent infringement as long as the control is 'proportioned' to the danger threatened. It is also contended that the realities of the situation limited by concepts of necessity and proportionality should control actions rather than the inflexible 12 mile limit. Allowable action should include before the fact regulation to prevent accidents as well as measures taken afterward. The article concludes that the most desirable approach is to reduce the likelihood of such situations as the Torrey Canyon incident through international agreement on navigational aids, traffic routes, and restoration measures. (Kahle-Fla) W69-02333

COAL MINING EFFECT ON BUSSERON CREEK WATERSHED, SULLIVAN COUNTY,

Indiana Univ., Bloomington. Don M. Corbett, and Allen F. Agnew. Water Resources Res Center, Rep of Invest No 2, 187 p, July 1968. 23 fig, 1 plate, 37 tab, 8 ref.

Descriptors: *Acid mine water, *Indiana, Water quality, Discharge (Water), Storm runoff, Hydrographs, Dams, Reservoirs, Acidity, Iron, Sulfates. Identifiers: Busseron Creek, Wabash River, Sullivan County (Indiana).

The chemical quality of water in the Busseron Creek Watershed, tributary to the Wabash River, Indiana, was studied to determine the effects of acid mine drainage on water quality in 26 reservoirs being constructed by USSCS. Sedimentation damage from coal mining is not serious. Streamflow data were collected for 2 years and 450 chemical analyses were made. Adic water is found in Big Branch in which 26% of the drainage area is disturbed by surface mining, Buttermilk Creek, 7% disturbed, and Sulfur Creek, 12% disturbed. The acid is contributed by both surface and un-derground mining. The other streams in the watershed are relatively unaffected by mining and have good quality water. Flushing of the streambeds during high flow causes temporary high concentrations of mining waste pollutants. Magnitude and frequency of storm runoff affect acid concentrations in the watershed. Present mining operations contribute no acid, which originates in old waste piles and surface mining areas. (Knapp-USGS) W69-02341

NUMERICAL STUDIES OF UNSTEADY DISPERSION IN ESTUARIES,

Massachusetts Institute of Technology, Cambridge, and Gibbs and Hill, Inc., Boston, Massachusetts. For primary bibliographic entry see Field 02L. For abstract, see.

W69-02346

THE VARIATION OF WATER TEMPERATURES DUE TO STEAM ELECTRIC COOLING OPERATIONS.

Vanderbilt Univ., Nashville, Tennessee, and Johns Hopkins Univ., Baltimore, Maryland. John E. Edinger, Derek K. Brady, and Willard L.

Graves.

J Water Pollut Contr Federation, Vol 40, No 9, pp 1632-1639, Sept 1968. 8 p, 4 fig, 3 ref.

Descriptors: *Water temperature, *Heated water, *Thermal powerplants, *Cooling water, Lagoons,

In a study of temperatures in an artificial lake constructed to cool water discharged from a generating station before returning it to the stream from which it was taken, it was found that water temperatures vary with time due to changing plant loading and meteorological conditions. The time-averaged temperatures as well as the amplitude of the plant temperature variation decrease with distance from the discharge area and approach the water temperatures that would result from meteorological influences alone. As part of a continuing research on condenser water discharge, a study of the combined influence of varying plant loading and meteorological conditions on water temperatures has been made to test various time-varying prediction methods. Derivation of exponential equations used and a sample problem are included. (Knapp-USGS) W69-02350

EFFECT OF DROUGHT ON STREAM QUALI-TY IN NEW JERSEY,

U. S. Geological Survey, Trenton, New Jersey For primary bibliographic entry see Field 02É. For abstract, see. W69-02352

MINNESOTA MILL RADIOACTIVITY IN NICIPAL WATER DECEMBER 1967. SUPPLIES JULY-

Minnesota Department of Health, Division of Environmental Sanitation.

Radiol Health Data and Rep, Vol 9, No 10, pp 566-567, Oct 1968. 2 p, 1 fig, 2 tab, 1 ref.

Descriptors: *Radioactivity, *Surface waters, *Municipal water, *Minnesota. Identifiers: *Beta radioactivity, *Alpha radioactivi-

Beta and alpha radioactivity of samples of 9 Minnesota streams used for municipal water supplies are tabulated. Analytical procedures are briefly described. All the water supplies analyzed are well below the maximum recommended radioactivity standards for drinking water. (Knapp-USGS)

W69-02358

RADIOACTIVITY IN NEW YORK SURFACE WATER, JUNE-DECEMBER 1967.

New York State Department of Health, Division of General Engineering and Radiological Health.

Radiol Health Data and Rep, Vol 9, No 10, pp 568-569, Oct 1968. 2 p, 1 fig, 2 tab, 2 ref.

Descriptors: *Radioactivity, *Surface waters, *New York, Strontium radioisotopes. Identifiers: *Beta radioactivity.

Gross beta radioactivity is reported for 27 sampling stations and Sr-90 is reported for 2 stations in New York, June-December, 1967. The sampling program was initiated in 1955. The methods of analysis are briefly described and any anomalously high radioactivity levels are explained. (Knapp-USGS) W69-02360

DIFFERENCE MODELING OF STREAM POL-LUTION,

Oregon State Univ., Corvallis, and New York Univ., New York.

Only, New Tork.

David A. Bella, and William E. Dobbins.

ASCE Proc, J Sanit Eng Div, Vol 94, No SA 5, Pop 6192, pp 995-1016, Oct 1968. 22 p, 11 fig, 4 tab, 4

Descriptors: *Water quality, *Estuaries, *Mathematical models, *Path of pollutants, Computer models, Digital computers, Tides, Water pollution, Dispersion.

Identifiers: Finite difference methods.

Finite-difference methods are developed for the numerical analysis of BOD and dissolved oxygen profiles confined to cases which may be treated as one-dimensional problems. Temporal and spatial variations of hydraulic parameters and sources and sinks of BOD and dissolved oxygen can be incorporated into the models developed. Results obtained by the methods developed compare favorably to the results of available analytical solutions. For estuaries, the methods are applicable to the analysis of the variations of BOD and dissolved oxygen profiles within a tidal cycle. Significant variations of these profiles from those obtained by the commonly used quasi steady-state approach are demonstrated. The spreading which results from the tidal velocity variation is shown to have a significant effect on the BOD and dissolved oxygen profiles. The methods developed should prove useful in studies of estuaries in which the tidal variations are large and the temporal variations in the strengths of the BOD and dissolved oxygen inputs are great. (Author) W69-02367

DISPERSION PREDICTIONS IN NATURAL STREAMS,

U. S. Geological Survey and California Univ.,

Berkeley. Hugo B. Fischer. ASCE Proc, J Sanit Eng Div, Vol 94, No SA 5, Pop 6169, pp 927-943, Oct 1968. 17 p, 2 fig, 3 tab, 12

Descriptors: *Dispersion, *Path of pollutants, *Tracers, *Routing, Digital computers, Computer models, Radioisotopes, Gold radioisotopes, Computer programs.

Identifiers: Longitudinal dispersion, Copper Creek (Va.), Clinch River (Tenn.), Powell River (Tenn.), Coachella Canal (Cal.).

Data from longitudinal dispersion studies by Data from longitudinal dispersion studies by radioactive tracer, conducted by the United States Geological Survey during 1959-1961, are reanalyzed using more recent techniques. Data from 10 tests in 6 streams are examined. Methods available in the literature for calculating dispersion coefficients from tracer data are reviewed, and different methods applied to the same data are found to yield different results. A new method (routing

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procedure) is proposed, which uses a computer program to determine whether a suggested dispersion coefficient for a given stream predicts downstream tracer passage from upstream data. If the prediction is not adequate, the coefficient is adjusted until the coefficient giving the most accurate prediction is found. The dispersion coefficients obtained by the routing procedure are used to test a theory for predicting dispersion coefficients, proposed by the writer in a separate paper. The predicted and observed coefficients agree within 30% in half of the tests, and in the remainder (including some highly nonuniform streams) within a factor of 4. (Author) W69-02368

SELECTIVE EROSION OF SOIL FERTILITY CONSTITUENTS,

Wisconsin Univ., Madison, Dept. of Soils. H. F. Massey, and M. L. Jackson. Soil Sci Soc Am Proc, Vol 16, pp 353-356, 1952. 4 p, 1 fig, 5 tab.

Descriptors: *Eutrophication, *Nutrients, *Soil erosion, *Leaching, Erosion, Soil properties, Soil chemistry, Fertilizers, Soil groups, Water pollution sources, Regression analysis, Correlation analysis, Estimating equations, Wisconsin, Runoff, Organic matter, Nitrogen compounds, Phosphorus compounds, Potassium compounds, Ammonium compounds

Identifiers: Fayette silt loam, Almena silt loam, Miami silt loam, Silt loams, Predictive equations, Available phosphates, Exchangeable potassium, Organic nitrogen, Ammonia nitrogen.

Runoff samples from experimental plots at four lo-cations in Wisconsin were analyzed for total soil material, organic and ammonia nitrogen, available phosphorus, and exchangeable potassium. Correlation studies were carried out to relate selectiveness of the erosive process for a given fertility con-stituent to quantity of eroded soil and concentration of suspended solids in runoff. The relationship was found to be highly significant (probability level, 0.01), with multiple correlation coefficients of 0.63 for available phosphorus, 0.79 for nitrogen and for organic matter, and 0.87 for exchangeable potassium. Selectiveness of the erosive process for the four fertility constituents determined increases in the order: organic matter, organic and ammonia nitrogen, available phosphorus, exchangeable potassium. At average values of erosiveness encountered in this study, the eroded soil material coptained 2.1 times as much organic matter, 2.7 times as much nitrogen, 3.4 times as much available phosphorus and 19.3 times as much exchangeable potassium as the soil proper. Analysis of regression equations derived by methods described by author indicate that these four silt loam soils fall in two classes, with Almena, 3% slope, and Miami, 9% slope, exhibiting less selective erosion, and two Fayette soils, 20% and 11% slope, exhibiting more. W69-02370

5C. Effects of Pollution

LIABILITY FOR INJURY TO PROPERTY OC-CASIONED BY OIL, WATER, OR THE LIKE FLOWING FROM WELL,

G. Van Ingen. 19 ALR 2d 1025-1045 (1951).

Descriptors: *Saline water, *Oil wastes, Natural gas, Oil, *Oil wells, Artesian wells, *Remedies, Judicial decisions, Damages, Pollution, Wells, Oily water, Legislation.

Identifiers: Gas wells, Salt wells, Sulfur wells, Injunction, Negligence.

Owners and operators of gas or oil wells are generally liable for injury to another's property caused by oil or water flowing from the wells. Liability of a lessee of oil or gas wells to the owner or lessee of surface lands embraced in the lease is limited to injury to parts of the land not essential to his operations. In addition, owners or operators of gas or oil wells are liable for injury to property caused by stream pollution. Liability is usually based on negligence or nuisance, although in a few cases it is predicated on statute. A few cases have extended liablity to include injunction as well as damages. Where several operators have contributed to the injury they have been held jointly, jointly and severally, or severally liable. Owners of salt or sulfur wells may be enjoined from depositing salt and sulfur into streams so as to pollute them or injure lower property. Owners of water wells have been held liable for allowing flow from the wells to injure lower land; but in cases where the water was allowed to flow into a natural watercourse without negligence or malice, no liability was found, even though a lower owner was injured. (Kahle-Fla) W69-02011

LIBBRA V MT OLIVE AND STAUNTON COAL CO (LIABILITY FOR FLOODING AND CON-TAMINATION).

29 111 App 2d 396, 172 N E 2d 813 (1961).

Descriptors: *Illinois, Watercourses, Damages, Flood damage, Crop production, Agronomy, Civil law, Judicial decisions, Value, Worth, Property values, Monetary worth, *Soil contamination, *Water pollution, Acid streams, Path of pollutants, Water pollution effects.

Plaintiffs sued defendant coal company for damages to their farm and its crops caused by slack, coal dust, and other debris deposited by de fendant in a stream which ran through both parties' premises. Due to the occasional overflow of the stream over a period of several years, the debris was deposited in varying amounts at different places on plaintiffs' property. As a result, the land was made too acidic to grow crop; and because it was deposited at irregular intervals, it was difficult to farm portions of the premises where there was no debris. The court awarded damages to the plaintiffs. Damage to the land was assessed at the difference in value before contamination and after contamination. Damage to the growing, unmatured crops was assessed at the value of the crop as it was when destroyed with the right of the owner to mature and harvest it at the proper time. Recovery for damage to crops for three succeeding years was allowed because of the continuing damages caused by subsequent flooding and debris deposits. (Scott-W69-02048

SEWAGE DISPOSAL IN THE REGION OF THE LOWER LAKE THUN,

W. Spring. Gas Wasserfach, Vol 104, pp 1397-1398, 1963.

Descriptors: Pumping, *Storm runoff, *Overflow, *Water pollution.

Attempts to maintain the purity of Lake Thun, Switzerland, have resulted in communal sewage disposal. Owing to the geological position of the lake the sewage flows without pumping to the lower region, where it reaches the pumping station at Durrenast and is then pumped into the treatment plant at Uetendorf, near the Aare. Additional pumping stations are planned for Gwatt, Einigen, Spiez and Faulensee, and special reference is made to the problems of planning sewage works for the future, in which the population index should be considered. The author also discusses the effect of storm-sewage overflows on receiving waters. W69-02213

THE EFFECT OF FRESH-WATER RUN-OFF ON A POPULATION OF POLYCHAETOUS ANNELIDS, **ESTUARINE** A. N. Stone, and D. J. Reish.

Bull So Calif Acad Sci, Vol 64, pp 111-119, 1965.

Descriptors: *Estuaries, *Storm runoff, Water pol-*Bioindicators. Identifiers: California.

Studies were carried out over a period of 15 months on the effect of run-off from rainfall on 3 species of estuarine polychaetes in Southern California. It was found that the worms were killed or reduced in numbers by rainfall in excess of 0.5 inch, but repopulation by larvae of the same species occurred rapidly. W69-02215

EFFECTS ON WINTER STORM RUNOFF ON VEGETATION AND AS A FACTOR IN STREAM POLLUTION.

For primary bibliographic entry see Field 04C. For abstract, see W69-02216

A LAKE'S RESPONSE TO ITS ENVIRONMENT, Robert O. Sylvester, and George C. Anderson. ASCE Proc, J of Sanit Eng Div, Vol 90, No SA1, Pt1. Feb 1964.

Descriptors: *Water pollution, *Recreation facilities, *Runoff, Nutrients, Deterioration, *Storm runoff.

Identifiers: Dilution, *Urban drainage, Bacteriological sampling.

Green Lake in Seattle, Wash., was studied to find the causes underlying its heavy algae blooms and alleged condition of pollution so that its recreational potential might be realized. Data were obtained on urban runoff, lake shore runoff, subsurface inflow, algae populations, waterfowl, composi-tion of sediments, effect of wind-induced currents on water quality, and requirements of competing recreational water uses. Water and nutrient budgets are presented. Nutrient additions sustain heavy algae blooms throughout most of the year and little can be done to reduce these additions Bacterial contamination is directly related to waterfowl populations. Changes in physical and chemical water quality are caused largely by algagrowth and decay. Recommendations are given for the addition of low-nutrient city water for dilution purposes, for dredging, and for shoreline improvements. It is recommended that increased quantities of storm water not be added. W69-02217

RELATIONS BETWEEN THE DEGREES OF DILUTION IN THE SEWERS AT THE STORM WATER OUTLET, AND IN THE RECEIVING STREAM.

For primary bibliographic entry see Field 04A For abstract, see . W69-02220

URBAN DRAINAGE AS A FACTOR IN EUTROPHICATION,

Federal Water Pollution Control Admin., Cincin-S. R. Weibel. Preprint, July 1967.

Descriptors: *Eutrophication, *Storm runoff *Overflow, Water pollution, Nutrients, Sewers Sewage treatment, Grants. Identifiers: *Combined sewers, *Urban drainage.

Stormwater runoff and combined sewer overflow as sources of water pollution, including nutrien contributions are discussed. Maps show future ur banization patterns and present distribution o states and their communities served by combiner sewer systems. Tables showing average concentrations and computed annual amounts of con stituents, including nutrients, produced per square mile by the several sources such as rainfall, com munity sewage, urban stormwater runoff and com bined sewer overflows, are presented. These in dicate that all are significantly concentrated i some respect as to warrant consideration in ap praising sources of pollution, particularly nutrients of area, community sewage heads the group, followed in order of decreasing unit production b

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combined sewer overflow, storm water runoff from a residentialtcommercial area and rainfall. Urban stormwater runoff as a water resource is discussed. Comments on studies and practices representing the variety of efforts to control pollution from storm water runoff or combined sewer overflows are presented. Treatment of extraneous flows in sanitary sewers is also included. Government research contract and demonstration grant programs to provide assistance to qualified workers interested in contributing to methods for control of storm and combined sewer sources of pollution are

W69-02222

SOME FORMS OF ABSOLUTE LIABILITY FOR WATER POLLUTION,

For primary bibliographic entry see Field 06E. For abstract, see .

CONTROLLING INDUSTRIAL WATER POLLU-TION: COLOR THE PROBLEM GREEN,

lowa Univ. Law School.

For primary bibliographic entry see Field 05G. For abstract, see.

W69-02331

EFFECTS OF SURFACE MINING ON FISH AND WILDLIFE IN APPALACHIA, Bureau of Sport Fisheries and Wildlife. Joseph A. Boccardy, and William M. Spaulding, Jr.

Bur of Sport Fisheries and Wildlife, Resource Publication 65, 20 p, June 8, 1968. 10 fig, 4 tab, 27

Descriptors: *Mine drainage, *Aquatic environ-ment, *Fish, *Wildlife, Fishkill, Fish management, Fishing, Water quality, Appalachian Mountain Re-

The effects of strip and surface mining on the fish and wildlife resources in eight Appalachian States were studied during a tour of mined areas by members of a team of specialists from six Federal agencies. Surface mining has caused extensive damage to fish and wildlife habitats and populations. A total of 832,605 acres of land have been disturbed; 81% of which are in Ohio, Pennsylvania, and West Vir-ginia. More than 5,000 miles of Appalachian streams and 13,800 acres of impoundments have been seriously contaminated by acid mine water, some of it from surface mining. Additional water has been adversely affected by tremendous quantities of silt and sediment. Reclamation of mined lands is needed. Three of the eight States visited in 1965-66 had no laws requiring restoration of stripmined lands, and other States needed stronger laws and more enforcement. Virginia and Tennessee have since passed laws governing strip mining. Reclamation as currently practiced in the Appalachian region does not adequately restore mined lands to minimal standards necessary to protect and improve fish and wildlife resources. (Author) W69-02356

A SAMPLE DESIGN FOR INVESTIGATING THE EFFECTS OF STREAM POLLUTION ON WATER BASED RECREATION EXPENDITURES,

Pennsylvania State Univ., Institute for Research on Land and Water Resources.

Wesley H. Long.
Water Resources Bull, Vol 4, No 3, pp 19-26, Sept 1968. 8 p, 1 tab, 5 ref, 1 append.

Descriptors: *Recreation, *Water pollution, *Cost analysis, *Water sports, Aesthetics, Attitudes, Economic impact, Public health, Safety, Regresion analysis, Sampling.

A sample design is presented for selecting streams in an investigation of the relation between water

pollution and water based recreation expenditures. The design is a proportional sample of clusters of streams stratified in a two-way scheme. The clustering is achieved by sampling 7 1/2 minute topographical maps, and the stratification by using measures connected with water pollution to classify the clusters. The design is based on considerations of economy in data collection and computational efficiency. A distinctive feature of the design is that data collected are to be used in a regression analysis. Thus, the sample size is determined by trying to achieve a given degree of precision for the regression coefficients. (Author) W69-02357

MOLYBDENUM AS A FACTOR LIMITING PRIMARY PRODUCTIVITY IN CASTLE LAKE, CALIFORNIA,

California Univ., Davis, Dept. of Zoology. For primary bibliographic entry see Field 02K. For abstract, see .

5D. Waste Treatment **Processes**

RUTH V AURORA SANITARY DIST (POLLU-TION ABATEMENT).

For primary bibliographic entry see Field 05B. For abstract, see .

WATER POLLUTION -- 1968, PART 1.

Hearings - Subcommittee on Air and Water Pollution, Committee on Public Works, U S Senate, 90th Congress, Second Session, pp 1-199, March 27, 1968. 199 p, 4 append.

Descriptors: Legislation, Air pollution, Water pol-Jution, *Water pollution control, Water pollution sources, Water purification, *Sewage treatment, *Water rates, Eutrophication, *Waste water treatment, Waste water (Pollution).

Identifiers: *Federal Water Pollution Control Act.

Hearings of the subcommittee of air and water pollution taken on March 27, 1968 are covered. The matters before the subcommittee were the activities of the Federal Water Pollution Control Administration and water quality standards. The reason for the hearings was pending legislation on air and water pollution being considered by the full committee on Public Works. The hearing record reflects the status of states complying with federal water quality standards. Much of the material found in the record is concerned with municipal sewers and purification plant facilities. The appendix includes a listing of state water quality standards, the status of federal approvals, and a report of activities of the Federal Water Pollution Control Administration through June, 1968. (Crabtree-Fla) W69-02063

MUNICIPAL SEWER SERVICE CHARGES.

Hearings - Subcommittee on Air and Water Pollution - Committee on Public Works U S Senate - 90th Congress, Second Session, pp 59-174, Mar 27,

Descriptors: *Cities, *Municipal wastes, *Financing, Municipal water, *Water rates, Water purification, Sewage treatment, Sewerage, United States, Community development, Sewage disposal, Local governments, Utilities, Water treatment, Water

Identifiers: *Sewage charges.

This article analyzes the fundamentals that require consideration when a municipality adopts a system of charges for the use of its sewer system and purification-plant facilities. It also presents a series of sewer-service charges in use in selected areas throughout the United States, and gives some indi-cation of the sewerage system that they help finance. Also included is a study that shows how cities can design and operate their sewerage purification plants so as to make them centers of civic interest and places where people like to come and visit. The article was taken from the American City Magazine. (Crabtree-Fla) W69-02064

MODERN SEWER-SERVICE CHARGES, PART I - WHY CITIES NEED THEM.

Hearings - Subcommittee on Air and Water Pollution - Committee on Public Works U S Senate -90th Congress, Second Session, pp 67-71, Mar 27,

Descriptors: *Sewerage, *Financing, Taxes, *Tax rate, Water rates, Costs, Local governments, Cities, Tennessee, Environmental sanitation, Sewage, Sewage treatment, Sewage districts.
Identifiers: *Sewer-service charges, Chattanooga.

The reason for the use of sewer service charges is that they avoid taxes. The principle benefit is that the public does not like taxes but will accept a charge that pays for a service that it comprehends. Shifting the financial burden of sewerage works from ad valorem taxes to sewer-service charges results in a wider array of contributors. Churches, schools, and other governmental units which do not pay property taxes immediately become paying customers. Additionally, the homeowner pays more nearly in proportion to use and commercial users pay likewise rather than being taxed on assessed valuation. The service rates of Chattanooga, Tennessee are presented. (Crabtree-Fla) W69-02065

MODERN SEWER-SERVICE CHARGES, PART II - SOME TYPICAL RATES.

Hearings - Subcommittee on Air and Water Pollution Committee on Public Works U S Senate - 90th Congress, Second Session, pp 72-77, March 27,

Descriptors: Iowa, Minnesota, Pennsylvania, Ohio, Florida, Wisconsin, *Sewerage, Financing, *Water rates, *Plastics, Pipes, *Tax rate, Cities, Sewage treatment.

Identifiers: *Sewer-service charges, Ames (Iowa), Anoka (Minnesota), Bethal Park (Pennsylvania), Circleville (Ohio), Hollywood (Florida), Kissimmee (Florida), Lorain (Ohio), Oshkosh (Wiscon-

This part presents the sewer-service rates of eleven typical municipalities. Several systems of charging are utilized. These are: (1) cubic feet, (2) gallons, (3) facility, (4) fixture, and (5) flat rate. Also included in this part is a short article on how a plastic-pipe is useful in preventing salt-water infil-tration. (Crabtree-Fla) W69-02066

WATER POLLUTION - 1968 PART I -(MODERN SEWER-SERVICE CHARGES, PART 3. METERED VS FLAT).

Hearings - Subcommittee on Air and Water Pollution, Committee on Public Works, U S Senate, 90th Congress, Second Session, pp 78-81, March 27, 1968. 4 p, 4 tab, 5 ref.

Descriptors: *Rates, Sewage disposal, *Municipal wastes, Sewage districts. Identifiers: *Sewage rates.

The merit of metered sewer-service charges as compared to the flat rate charge is discussed. 85% of water distributed today is metered, but only a slight majority of cities using sewer-service charges slight majority of cities using sewer-service charges favor metered charges. Some of the reasons for this are: (1) There is no inexpensive and convenient

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sewage meter; (2) All of the water which flows through a customer's water meter does not find its way to the sewer; (3) Flat rates usually reduce administration costs; and (4) The difficulty of treating the sewage varies with strength as well as with volume. However, because flat rates are based on fixtures and not usage, metered rates yield revenues more nearly proportional to the volume of sewage. (Crabtree-Fla) W69-02067

WATER POLLUTION -- 1968, PART 1 (MODERN SEWER-SERVICE CHARGES, PART 4. THAT ELUSIVE PERCENTAGE).

Hearings - Subcommittee on Air and Water Pollution, Committee on Public Works, US Senate, 90th Congress, Second Session, pp 82-86, March 27, 1968. 5 p, 9 tab.

Descriptors: *Rates, *Sewage, Sewers, Sewage districts

Identifiers: Sewer-service charges

The practice of establishing sewer-service charges as a particular proportion of the water rate is examined. Generally, sewer-service charges are between 30% and 200% of the water rate. Primary attention is given to comparing various cities as to how their water rates compare with their sewer-service charges. The conclusion is that percentage rates mean little because dollars, not percentages of the water bill, construct and operate plants. (Crabtree-Fla) W69-02068

WATER POLLUTION -- 1968, PART I -- (MODERN SEWER-SERVICE CHARGES, PART 5. PENALTIES HURT YOUR UTILITIES).

Hearings - Subcommittee on Air and Water Pollution, Committee on Public Works, U S Senate, 90th Congress, Second Session, pp 87-92, March 27, 1968. 6 p, 9 tab, 4 ref.

Descriptors: *Rates, Sewage districts, *Sewage. Identifiers: Sewage rates.

Penalties for late payment of sewer service bills and discounts for early payments of these bills are treated. The argument is that both should be eliminated; the penalty because it denotes an over-bearing attitude, and the discount because it evokes thoughts of a bargain basement. Enhancement of a city's 'corporate image' is achieved by eliminating penalties and discounts. (Crabtree-Fla) W69-02069

STORM SEWAGE SEPARATION BY HELICAL

C. H. Dobbie, and J. W. Wielogorski. Survr Munic Cty Engr, Vol 127, No 3839, pp 141-

Descriptors: *Storm runoff, *Overflow, Weirs, *Model studies.

An improved storm-sewage overflow is proposed, incorporating bends in the channel which produce helical flow, separating heavier materials and allowing the less-polluting liquid to flow over a weir along the outer wall of the channel. Tests are being conducted on a hydraulic model, which is illustrated, and it is hoped to incorporate this type of overflow in an existing sewerage system soon. W69-02090

WASTE TREATMENT PLANT MODIFIED FOR INCREASED SOLIDS LOADING,

A. J. Reisdorph. Pub Works, Vol 96, No 4, pp 113-114, 1965.

Descriptors: *Storm runoff, *Overflow, Discharge (Water), Sewage treatment.
Identifiers: *Combined sewers, Spokane (Wash).

The primary sewage-treatment plant at Spokane, Wash., has been enlarged to provide adequate treatment for the recently-added load of industrial waste waters (mainly from packing houses). The additional equipment includes a preliminary aeration unit for grease removal, and increased clarifying and digesting capacity. A storm-water overflow device selects the upper and lower strata in the combined sewers, containing comparatively clean water and grit respectively, for discharge direct to the Spokane river. W69-02110

THE TREATMENT OF STORM SEWAGE.

B. D. Steele.

Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil En-

Descriptors: *Water pollution, *Storm runoff, *Overflow, *Automatic control, Sewage treatment. Identifiers: *Storage tanks.

A prime objective of the virtual resewerage of an area of about 27,900 acres at Coventry is the elimination of pollution in the river system, which forms the headwaters of the River Avon. The solution lies in the building of Storm Balancing Stations. In time of rain all flows in excess of 3 d.w.f. are spilled off into mechanically scraped circular tanks. Sludge is evacuated to the sewer. The provision of additional tanks or other processes is feasible. The tanks are probably unique in that overflow to the tanks, operation of the scraping mechanism, continuous pumping of sludge, sampling, tank emptying to the sewer and rising main emptying are all automatic. Results are beginning to become available from one station. Conclusions are that if in the future a proportion of the flow in a foul sewer may be discharged directly to the river the device for separating the elements must be designed on a more scientific basis, and the solution may lie in the provision of storm balancing tanks. W69-02116

IMPROVEMENTS IN SYSTEMS OF 'COM-BINED' SEWERAGE.

For primary bibliographic entry see Field 04A. For abstract, see . W69-02123

IMPROVEMENTS IN SYSTEMS OF COMBINED SEWERAGE.

For primary bibliographic entry see Field 04A. For abstract, see . W69-02124

FOCUS ON RESEARCH. WATER POLLUTION RESEARCH AND THE MUNICIPAL EN-GINEER,

A. L. Downing

J Instn Munic Engrs, Vol 92, pp 185-188, 1965.

Descriptors: *Water pollution, Automatic control, Instrumentation, *Storm runoff. Identifiers: *Combined sewers.

The work and publications of the Water Pollution Research Laboratory relating to problems encountered by municipal engineers are outlined. Brief details are given of recent investigations on the effects of pollution on fish; the oxygen balance in rivers and estuaries; the dispersion of sewage from coastal outfalls; the fundamentals of established sewage-treatment processes, and the development of instruments for their automatic control; the operation of extended-aeration plants; tertiary treatment for polishing sewage-works effluents; the inhibition of sludge digestion by detergents and certain industrial effluents discharged to sewers; and the composition and flow of storm sewage in combined systems. W69-02126

STORM WATER AND COMBINED SEWAGE OVERFLOWS,

S. A. Greeley, and P. E. Langdon.
ASCE Proc, J Sanit Eng Div, Vol 87, No SA1,

Descriptors: *Storm runoff, *Overflow, *Water pollution, Storms, Sewers, *Biochemical oxygen demand, Sewage treatment, *Pathogenic bacteria. Identifiers: *Combined sewers. *Chlorination.

Most of the larger and older cities in the U.S.A. are served by combined sewerage systems resulting in pollution of waterways through overflows during storms. Such pollution could be removed by complete separation of storm water and sanitary sewage by the construction of a new system of sanitary sewers, but this would be expensive and inconvenient and is therefore of limited application. The interception and treatment of the dry weather flow and the first flushings of storm water will reduce the volume of sewage discharged through overflows to about 3 per cent of the total sewage flow, and with complete treatment of the intercepted flow about 90 per cent of the BOD can be removed. Treatment of intermittent discharges from overflows by retention and chlorination to remove floating solids and bacterial contamination can also improve conditions in receiving streams at reasona-W69-02131

STORM WATER OVERFLOW IN EXISTING COMBINED SEWERS.

For primary bibliographic entry see Field 04A. For abstract, see . W69-02135

EQUIPMENT, METHODS AND RESULTS FROM WASHINGTON, D C, COMBINED SEWER OVERFLOW STUDIES,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02137

SEPARATE SYSTEMS-COMBINED SYSTEMS. E. Kuntze

Abwass Technik, Vol 17, No 1, pp 8-10, 1966.

Descriptors: *Sewers, Sewage treatment, Water pollution, *Storm runoff, *Overflow, Pumping, Groundwater, Velocity.
Identifiers: *Combined sewers.

The author discusses, on the basis of experience, the advantages, disadvantages and economics of existing sewerage systems and compares the efficiency of the separate system with the combined system. Taking into account the requirements for sewage treatment and prevention of pollution of streams, detailed information is given on how risks of pollution by storm-sewage overflows and rain-water pumps can be avoided. Taking into con-sideration the availability of existing sewerage systems, receiving waters, and local conditions, the author suggests that it must be decided individually whether the separate or the combined system is preferable. Where a new sewerage system is to be installed and good ground-water conditions prevail, the combined system was found to be more economical and adaptable; however, where the velocity of flow is low and a higher water level is required, the separate system is preferable especially when mineral substances can be washed away by the storm-sewage system. W69-02139

THE TRUNK SEWER SYSTEM AND THE SEWAGE-TREATMENT PLANT OF THE TOWN OF UTRECHT. HISTORY AND TECHNI-CAL LAY-OUT, M. Lugt.

Ingenieur's Grav, Vol 77, G.1-G.7 and G.9-G.20,

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Waste Treatment Processes—Group 5D

Descriptors: *Sewage treatment. Identifiers: *Combined sewers, Utrecht (Netherlands)

After outlining the events that led to the construction of sewage-treatment facilities at Utrecht, the Netherlands, the author gives an illustrated description of the combined sewerage system and new treatment plant. The plant, which is designed to serve a population of 400,000, provides treatment by high-rate biological filtration with recirculation of effluent. Sludge is digested in two stages, dried on beds and used as fertilizer; sludge gas is used in dual-fuel engines to generate electricity. W69-02140

WEST HARTLEPOOL SEWERAGE SCHEME WILL CLEAN BEACHES.

For primary bibliographic entry see Field 04A. For abstract, see . W69-02143

DESIGN OF RAIN OVERFALLS IN DRAINAGE NETWORKS AND SEWAGE TREATMENT PLANTS,

G. Mueller-Neuhaus

Gesundsheits-Ing, Vol 71, pp 9-10, 149-52, May 1950.

Descriptors: Drainage systems, *Storm runoff, *Water pollution, Design, *Overflow, Sewage treatment.

Identifiers: *Urban drainage.

Design of rain overfalls in drainage networks and sewage treatment plants; considerable difference between run-off and sewage flow off with varying density of population; average pollutions of city waste water; degree of dilution required for sewage, diagrams, charts. W69-02144

EFFECT OF VARIOUS STORM-WATER PROTECTIVE MEASURES ON THE SEWAGE SYSTEM, W. Munz.

Schweiz Z Hydrol, Vol 28, pp 184-237, 1966.

Descriptors: *Storm runoff, *Sewage treatment, *Overflow, Biochemical oxygen demand, *Planning, Sewage effluent, Water pollution con-trol, *Rainfall-runoff relationships. Identifiers: *Combined sewers, *Storage tanks, *Calculations, Suspended solids.

The author describes the mathematical analysis of the effect and efficiency of various decisions which might be necessary in planning treatment for the flow from a combined sewerage system, and calculates the annual amounts of setteable solids and BOD which may be removed by various settings of storm-sewage overflows and volumes of storage tanks. Storage tanks are useful when high degrees of treatment are required. The relation between rainfall and run-off from various types of terrain, the duration of run-off, and the quality of sewage in a combined system are considered, and the relation between the required quality of final effluent and the volume of the aeration tanks in an activatedsludge plant are estimated. W69-02145

ONE CITY'S APPROACH TO THE PROBLEM OF COMBINED SEWAGE OVERFLOWS, For primary bibliographic entry see Field 04A.

For abstract, see . W69-02161

THE TRUNK SEWER SYSTEM AND THE SEWAGE-TREATMENT PLANT OF THE TOWN OF UTRECHT. II. STORAGE CAPACI-TY OF SEWERS AND PUMP REGIME, J. W. C. Wammis.

Ingenieur's Grav, Vol 77, G. 23-G.31, 1965.

Descriptors: *Flow control, *Pumping, *Sewers, Instrumentation.

Identifiers: *Combined sewers, Utrecht (Netherlands), Capacity.

The sewerage of Utrecht, Netherlands, is designed as a combined system. To obtain maximal efficiency of operation at the sewage works it is important to equalize the flow to the plant throughout the day, and this is achieved by utilizing the storage capacity of the sewers and by selecting a suitable relation between the capacities of the pumps in the various pumping stations and the numbers of hours during which they operate. The pumps are operated by remote control from the main pumping station at the sewage works. W69-02162

SEWAGE WORKS DESIGN AND WET WEATHER FLOWS, R. K. Williams, and C. G. Wells.

J Inst Sew Purif, Pt 3, 361, 1959.

Descriptors: *Design, *Storm runoff, *Sewage treatment, *Sewage effluent, *Waste dilution, Water pollution.

The design of sewage works is usually based on the estimated dry weather flow, and the authors consider that more attention should be paid to wet weather flows. They suggest that full treatment should be provided for all flows up to 3 times dry weather flow; that flows from 3 to 5 times dry weather flow should be screened and settled; and that flows in excess of 5 times dry weather flow should be screened. In all cases the by-passed sewage should be mixed with the fully-treated effluent to dilute it before discharge. The frequency of peak flows in Salisbury, Southern Rhodesia, is discussed. The probable polluting effect of the different degrees of treatment and the effect of the suggested requirements on the design of the various treatment units are considered. W69-02164

DIVERSION AND TREATMENT OF EXTRANE-OUS FLOWS IN SANITARY SEWERS, L. W. Weller, and M. K. Nelson.

J Water Poll Control Fed, Vol 37, p 343, 1965.

Descriptors: Sewers, *Sewage treatment, Chlorination.

Identifiers: *Sewer infiltration.

In many sewerage systems, the maximal flows may be many times the average as a result of extraneous flows, defined as liquids entering the sanitary sewers through sources other than plumbing fixtures or process facilities. This may cause difficulties at the treatment plant, and the authors describe the facilities installed to divert and treat peak flows in the Mission Township district of Johnson County, Kans., in the Indian Creek district of Johnson County (see also Wat. Pollut. Abstr., 1965, 38, Abstr. No. 437), and in Kansas City, Mo. Peak flow are settled, skimmed, and in two cases chlorinated, before discharge, thus reducing possible pollution of the receiving streams. W69-02176

OIL RETENTION IN STORM-SEWAGE PUMP-STATIONS AND STORM-SEWAGE ING S TANKS,

A. Krauel. Gas Wasserfach, Vol 108, pp 48-51, 1967.

Descriptors: *Design, *Pumping, *Storm runoff, Water pollution control. Identifiers: Ruhr River (Germany).

A description, with diagrams, is given of the design and operation of various storm-sewage pumping works, which were installed at 60 points on the lower Ruhr against oil pollution. These works, and the oil separators incorporated, are designed in ac-cordance with the total rainfall of the area. Special reference is made to a reinforced-concrete oil separator, installed at the inlet of a large earth reservoir to prevent pollution of the ground water. W69-02181

INDUSTRIAL AND DOMESTIC WASTEWATER CONTROL IN THE METROPOLITAN DISTRICT, MIŁWAUKEE

R. D. Leary, and L. A. Ernest.
J Water Poll Control Fed, Vol 39, No 7, p 1223, July 1967.

Descriptors: *Sewers, *Sewage treatment, Water pollution.

Identifiers: *Storm sewers, Urban drainage, Milwaukee (Wis).

The Milwaukee Sewerage Commission provides wastewater collection and treatment facilities for the 18 municipalities located within the District as well as for 7 contract areas located within the drainage area. Industries are required to separate wastewaters for discharge to storm or sanitary sewers and where necessary to provide pretreatment. Separation of unpolluted and slightly polluted industrial wastewaters for discharge to storm sewers is stressed to reduce the volume requiring treatment. This philosophy is carried into the domestic wastewater area and separation is required on private property. Concentrated wastewaters which will not affect adversely the collection system or the treatment processes are accepted in the sanitary sewer system. Required industrial waste pretreatment facilities are therefore designed to remove prohibited materials from the wastewater and generally can be classed as primary treatment units. W69-02183

A NEW WASTE DISPOSAL SYSTEM,

E. Lindstrom.

Tidskr varme- vent-sanit-o kyl-Tek, Vol 29, pp 211-213, 230, 1958.

Descriptors: *Sewage treatment, *Plastic pipes, Storm runoff. Identifiers: *Storm sewers

In the proposed system, sewage from toilets is discharged separately from other household waste water by means of a vacuum maintained in the sewer, using a very small quantity of water to rinse the toilet bowl and form a water trap. The small amount of highly-concentrated sewage obtained would receive conventional treatment. Smalldiameter plastic pipes form adequate sewers and because of the vacuum present they may be laid at any gradient, even upwards. The remaining household waste waters can normally be discharged to receiving waters without treatment, using a similar sewerage system employing an hydraulic vacuum principle may also be used for discharge of storm waters and for conveying industrial waste waters to treatment plants. W69-02185

EFFECTIVENESS OF THE INTERCEPTION OF SEWAGE-STORM WATER MIXTURES, W. G. Shifrin, and W. W. Horner. J Water Poll Control Fed, Vol 33, p 650, 1961.

Descriptors: *Water pollution control, *Sewage treatment, Storm runoff. Identifiers: *St. Louis (Mo.), *Combined sewers, *Interceptor sewers, Dilution, *Capacity, Urban drainage

To reduce pollution of the Missouri and Mississippi Rivers in the St. Louis metropolitan area, Mo., it is planned to provide primary treatment of sewage. Most of the sewerage systems in the area are of the combined type, and the authors describe the method used to determine the amount of the mixture of sewage and storm water which should be intercepted for treatment. As the Mississippi River provides considerable dilution and is not used for

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Group 5D—Waste Treatment Processes

recreation nor as a source of water supply for some considerable distance below St. Louis, it is concluded that it is unnecessary to provide interceptor capacities in excess of the peak dry weather flow. W69-02212

SOME PROBLEMS IN THE HYDRAULIC DESIGN OF SMALLER TREATMENT WORKS, J. Lang

J Proc Inst Sew Purif, Pt 5, pp 482-490, 1964.

Descriptors: *Hydraulic design, Sewage treatment, *Storm runoff.

The author discusses some of the difficulties encountered in designing small sewage works which have small dry-weather flows but may receive large volumes of storm sewage. W69-02228

NO STORM-WATER BYPASS,

R. D. Leary.

Amer City, pp 93-95, Aug 1966.

Descriptors: *Sewage treatment, Equipment, *Storm runoff.

A sewage purification plant for Milwaukee is described in detail. Primary treatment is provided for an average flow of 60 mgd and can be expanded to a dwf of 120 mgd by the year 2000. Secondary treatment is also planned for the future. The plant is designed so that each part can handle the entire flow hydraulically. Any unit can be taken out of service for maintenance and the balance of units will handle the entire 320 mgd stormflow. Therefore no plant bypass is needed and no untreated sewage flows to the lake. W69-02229

PUBLIC HEALTH ENGINEERING IN A NEW TOWN--PROGRESS AND PROBLEMS, H. J. Lumley, H. B. Parker, and T. Steel. Instn Publ Hith Engrs J, Vol 66, pp 18-33, 1967.

Descriptors: *Surface runoff, *Discharge (Water), *Intakes, Sewage treatment. Identifiers: *Combined sewers, Urban drainage

This discussion on public health services in Crawley New Town, Sussex, includes a description of sewerage and sewage disposal facilities. The new sewerage system was designed to carry surface water directly to local streams and the river Mole: the only surface water to go into the foul sewer was to be that from the existing combined sewers. In practice this system has failed and the treatment works, which was designed to take a storm flow of 12 m.g.d., has, under extreme conditions, had to deal with 18 m.g.d. Penstocks had to be fitted to the sewer inlets to prevent flooding at the works, with the resultant 'backing up' of sewers in many parts of the town when these are closed. Various causes of the excessive storm flow have been suggested. The new sewage works provide treatment by the activated-sludge process, with diffused-air aeration. Sludge is digested and used as fertilizer on farmland. With an effluent standard of 15 p.p.m. suspended solids and 15 p.p.m. BOD to maintain and improve upon, it may soon become necessary to duplicate the works to deal with the sewage from a rapidly expanding population. The master plan for Crawley failed to make any provision for refuse disposal; as a result two unsatisfactory attempts have been made to establish controlled dumps. The first site had to be closed when liquor draining from it polluted a stream which developed heavy growths of sewage fungus. At the second site an attempt was made to terrace a hillside, but as a result of geological faulting local streams were again polluted. This situation has been alleviated by digging drainage trenches at the base of the hill to collect the effluent which is then pumped back up the hill side for treatment on land. This has not entirely removed the pollution or the accompanying smell of hydrogen sulphide, and as a further measure

potassium permanganate, which precipitates the hydrogen sulphide, is leached into the streams. The cost of mechanical methods of disposal are at present prohibitive and a long-term plan for refuse disposal is not yet possible. W69-02230

DWF OF 282,000 GPD FOR BRENTWOOD SEWAGE WORKS,

T. V. Martin.

Munic Eng, London, Vol 142, pp 1375-1376,

Descriptors: *Automatic control, Sewage treatment, Equipment, Sewage sludge, Sewage effluent, Storm runoff. Identifiers: *Storage tanks

The new sewage works of Brentwood, Essex, replacing the Lapwater Hall works which served a population of 1500, is designed to serve a population of 8000, with a design dry-weather flow of 0.282 m.g.d. Flows in excess of 3 times this value are automatically diverted to storm tanks from which flows in excess of 6 times dry-weather flow are discharged to irrigation plots and smaller flows pass with the settled sewage to the percolating filters. The rate of recirculation of effluent on to the filters is also controlled automatically in relation to the rate of the incoming flow. Final effluent is discharged to grass plots but flows in excess of 3 times dry-weather flow are pumped direct to the river. Sludge is digested and dried on beds; liquor from the digestion tanks and drainage from the drying beds are re-treated with the influent sewage. W69-02231

TURKEY CREEK SEWAGE PUMPING STA-

TION, W. E. Nusbaum.

Sewage Works, Vol 112, No 2, pp 58-62, Feb 1965.

Descriptors: *Water pollution control. *Storm runoff *Automatic control

Plant in conjunction with new diversion structure is part of plan for pollution control of Missouri River and will be located near mouth of Turkey Creek trunk sewer; sanitary sewage and industrial wastes will be intercepted and pumped through 48-in. force main to new sewage treatment plant located near confluence of Kansas and Missouri Rivers; storm flows will be bypassed directly to Kansas River; plant is equipped with five sewage pumping units of vertical, dry-pit type driven through direct connected intermediate shafting by electric drives mounted separately on main operating floor; pump operation, electrical supply and automatic features are described W69-02232

SOME APPLICATIONS OF RESEARCH IN THE DESIGN OF SEWERAGE AND SEWAGE-TREATMENT WORKS,

H. R. Oakley.

J Inst Sew Purif, Pt 1, pp 83-101, 1963.

Descriptors: *Storm runoff, *Runoff forecasting, Hydraulic design, Sewage treatment, Design, *Sewers, Equipment.

The author discusses some examples of the application of results of research to improve the design of sewerage and sewage-treatment facilities, including calculation of storm-water run-off, hydraulic design of sewers, design of sedimentation tanks and percolating filters, improved aeration in the activated-sludge processes, and methods for polishing effluents and for treatment of sludge. He points out that direct application of fundamental research to design is seldom possible, and an intermediate stage of development is usually necessary. W69-02233

EMERGENCY ALUM TREATMENT OF OPEN RESERVOIRS.

W. R. Ree.

J Amer Water Works Assoc, Vol 55, pp 275-281,

Descriptors: *Storm runoff, *Treatment, Water pollution control, *Turbidity. Identifiers: *Storage tanks.

The author describes experiences of the Department of Water and Power, Los Angeles, Calif., in the direct application of powdered alum to open reservoirs for reduction of high turbidities caused by storm run-off. This treatment has been found useful in emergencies, satisfactory results being obtained with alum doses of up to 85 p.p.m. It has also been used successfully for treatment of storm water before it enters the reservoirs. Experiments also showed that the storm water could be treated with liquid alum, and large storage tanks are being constructed at two sites for this purpose, to eliminate the need for mechanically driven feeders. W69-02234

CONTROL OF POLLUTION FROM COMBINED SEWER SYSTEMS,

Paul W. Reed.

1965 Public Works Congress and Equipment Show, sponsored by Amer Public Works Assoc, Los Angeles, Calif, Aug 31, 1965. 10 p, 8 ref.

Descriptors: *Storm runoff, *Water pollution, *Overflow, Sewage treatment.
Identifiers: *Combined sewers, *Sewer separation, Storage tanks.

Data from several cities concerning amount of pollution due to storm water overflow from combined sewers is given. Disadvantages of separating sanitary and storm sewers as a solution for the problem are discussed. Combined treatment and holding facilities are suggested as an alternative and various types are described. (Synopsis of this paper published in Public Works, pp 112-113, Aug, 1966). W69-02235

SOUTHEND-ON-SEA SEWAGE WORKS AND **PUMPING STATIONS,**

I. H. D. Savle

J Inst Sew Purif, Pt 3, pp 242-244, 1963.

Descriptors: *Sewage treatment, *Storm runoff, Pumping.

The pumping stations and sewage-treatment facilities for Southend-on-Sea, Essex, are described. Sewage is treated at Prittlewell by screening, removal of grit, and sedimentation before discharge to the Thames estuary; storm water is screened before discharge, and all screenings are disintegrated. Sludge is now digested before being pumped to the sludge farm at Barling. Provision has been made for returning water draining from the sludge farm to the main treatment plant, but in dry weather this effluent is used by farmers for crop irrigation. W69-02236

TREATMENT OF MUNICIPAL WASTE WATER, O. J. Schmidt.

SW Water Works J, Vol 48, No 5, pp 18-28, 1966.

Descriptors: *Runoff, *Water pollution, Sewage lagoons, Biochemical oxygen demand, Sewage treatment, Design.

The author discusses sources of pollution, including examples of pollution by run-off, and describes the performances of lagoons used for tertiary treat-ment at Peoria, Ill., at South St. Paul, Minn., and at Indian Creek, Kans. BOD removals during the periods studied ranged from 20 to 70 per cent. It is pointed out that it is difficult to assess the efficien-

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Ultimate Disposal of Wastes—Group 5E

cy of tertiary treatment in lagoons, which produce well-nitritied effluents, when the influent BOD changes from a carbonaceous to a nitrogenous nature. The high efficiency of tertiary treatment is illustrated by results from the plant at South Tahoe, Calif. Reduction of pollution by improvements in the design and operation of sewage works and by chemical treatment is considered briefly. W69-02237

METHOD OF CLEANING SEWER SYSTEMS,

E. J. Storia, and R. L. Voda.

U S Patent 3,170,814 (to Terra Chemical Corp) Feb 23, 1965.

Descriptors: *Sewers, *Storm runoff. Identifiers: Combined sewers, *Polymers.

It is claimed that storm-water and combined sewerage systems can be cleaned by adding a water-soluble, high-molecular-weight polyelectrolytic organic polymer, such as acrylic and methacrylic acid derivatives, to the catch basins in amounts of 0.1-1.0 gal. Rain water entering the system dissolves the polymer which acts as a coagulant for material in the sewer, and carries it through the system to discharge. W69-02238

SAINT NICOLAS: TECHNICAL DESCRIPTION OF THE SEWAGE-TREATMENT WORKS, M. Theinpont.

Techq Eau Assain, Vol 19, No 219, pp 29-40, and No 220, pp 29-40, 1965.

Descriptors: *Storm runoff, *Sewage treatment, Automatic control, Sewage sludge, Sewage ef-

A detailed, illustrated description is given of the new biological-filtration plant at Saint-Nicolas, Belgium, which has been designed to treat a daily dry-weather flow of 10,800 m3 of sewage and industrial wastes, with provision for reception of 3200 m3 per hour during storm flows, half of which can receive complete treatment. The percolating filters may be operated with alternating double filtration and recirculation, and the final effluent is discharged from humus tanks to Paddeschootbeek. Sludge receives primary and secondary digestion, during which it is heated by heat-exchange units situated outside the tanks; after drying on beds, the digested sludge provides a useful fertilizer. The operation of the plant is controlled automatically from a central control room, and its flexibility is illustrated by appended flow diagrams. W69-02239

SEWERAGE AND STORM-FLOW TREAT-MENT, D. J. Weiner.

Water Pollut Contr Fed J, Vol 39, No 5, pp 741-746 39 ref

Descriptors: *Surveys, *Storm runoff, Sewage treatment, Tunnel construction, Instrumentation.

A brief review of the 1966 literature on sewerage and storm-flow treatment is presented. Topics included are tunnel construction, economics of pollution control measures, specific sources of run-off pollution, sewer maintenance programs, and the se of television in sewer inspection. W69-02240

IMPROVED SUBSURFACE DISPOSAL,

Public Health Service, Zuni, New Mexico, Indian Hospital, and Cincinnati, Ohio, National Center for Urban and Industrial Health.

For primary bibliographic entry see Field 05E. For abstract, see .

W69-02287

MINE WATER RESEARCH; THE LIMESTONE NEUTRALIZATION PROCESS.

Bureau of Mines, Pittsburgh, Pa., Pittsburgh Mining Research Center.

E. A. Mihok, Maurice Deul, and C. E. Chamberlain.

Bur of Mines Invest Rep 7191, 20 p, Sept 1968. 14

Descriptors: *Acid mine water, *Mine drainage, *Water pollution treatment, *Neutralization, *Limestones, Aeration, Settling basins.

A pilot plant for treating mine drainage by neutralization with limestone was designed, fabricated, and operated by the Bureau of Mines. The process consists of producing a very fine (minus 400-mesh) limestone slurry, mixing the slurry with the mine water, aerating the resulting mixture to remove carbon dioxide and precipitate iron, and separating the solids from the liquid by sedimentation. A mine discharge of pH 2.8, containing 1,700 ppm total acidity, 36 ppm ferrous iron, and 360 ppm total iron, was treated at rates from 300 to 400 gpm. The treated water ultimately reached a pH of 7.4 and contained no detectable iron. The resulting sludge compacted to approximately 1/3 the volume of sludge from mine water neutralized with lime. The advantages of the limestone process, compared with the conventional lime process, are as follows: Widespread distribution and lower cost of run-of-mine, indigenous limestone; simplicity of plant design; reduced hazards and plant operating and maintenance costs accruing from the use of less reactive chemical agent; higher solids concentration of the precipitated sludge; and no deleterious effect caused by accidental over-treatment. While total process costs could not be determined, it is conservatively estimated that the cost of treating mine water by the limestone process is 1/3 to 1/2 the cost of the lime process, depending on the characteristics of the water to be treated and the availability and quality of limestone used. W69-02293

STUDY OF SLUDGE HANDLING AND DISPOSAL,

Federal Water Pollut. Control Admin., Washing-

ton, D. C. R. S. Burd.

Fed Water Pollut Contr Res Ser Publication No WP-20-4, 326 p, May 1968. 74 fig, 17 tab, 451 ref.

Descriptors: *Sludge, *Sludge disposal, *Sewage treatment, *Water treatment, *Waste water treat-Sludge digestion, Drying, Incineration, Sewage lagoons, Chlorination, Odor.

Identifiers: Sludge handling, Composting, Land disposal, Ocean disposal, Odor control, Pipeline transportation, Utilization.

The subject of water and wastewater sludge handling and disposal is discussed in detail. New approaches are suggested for use by researchers, design engineers, and operators of treatment facilities. A major conclusion from the report is that additional support should be given to the research and development of better ways to treat the solid portion of wastewaters, after separation from the liquid. Other major conclusions of the report are: (1) Standardized accounting and reporting procedures are needed. (2) Sludge handling and disposal should be integrated into the total wastewater treatment system. (3) Wastewater sludge disposal could be considered as a part of total solids-disposal system that includes refuse and other solid wastes. (4) Incineration is a promising ultimate disposal technique. (5) Mechanical dewatering systems are replacing more primitive dewatering systems. (6) There is a trend to ocean disposal of sludge by coastal or near-coastal cities. (7) Raw sludge handling is becoming more popular. (8) The cost of ultimate sludge disposal for most installations ranges from \$5 to \$55 per ton of dry solids. W69-02294

WASTEWATER REUSE AT THE GRAND CANYON.

Arizona State Department of Health, Phoenix. Edmund C. Garthe, and Wilfred C. Gilbert. J Water Pollut Contr Federation, Vol 40, No 9, pp 1582-1585, Sept 1968. 4 p.

Descriptors: *Water reuse, *Reclaimed water, *Tertiary treatment, *National parks, Arizona, Irrigation. Identifiers: Grand Canyon National Park

Reuse of wastewater for general utility purposes has been practiced at Grand Canyon Village, Arizona, since 1925. The arid climate and the geology of the South Rim region led to water shortage as tourism brought increasing numbers of visitors. The reclamation plant, consisting of activated sludge treatment, anthracite coal filtration, and chlorination, has successfully produced water suitable for the flushing of toilets, boiler feed, cooling, and irrigation of shrubbery. The development of several new abundant sources of potable water has taken place and the future of the reclamation operation is being considered. (Knapp-USGS) W69-02349

5E. Ultimate Disposal of Wastes

IMPROVED SUBSURFACE DISPOSAL.

Public Health Service, Zuni, New Mexico, Indian Hospital, and Cincinnati, Ohio, National Center for Urban and Industrial Health.

Ronald A. Popkin, and Thomas W. Bendixen. J Water Pollut Contr Federation, Vol 40, No 8, Part 1, pp 1499-1514, Aug 1968. 16 p, 15 fig, 5 tab,

Descriptors: *Soil disposal fields, *Septic tanks, *Laboratory tests, Waste treatment, Soil physical properties, Biochemical oxygen demand, Chemical oxygen demand, Groundwater. Identifiers: Dosing rate.

In testing the application of liquid waste to a soil, both continued hydraulic acceptance and quality of the percolate were considered. Laboratory studies revealed that hydraulic acceptance as measured by the rate of wetting new surface area in a progressive ponding situation is influenced by the frequency of applying waste, the volume of waste applied, and the quality of waste applied. The rate of development of wetted absorption area decreased with decreased frequency of application and improved quality of the waste applied. Within limits the efficiency of use of absorption area was improved with higher loading rates; that is, the rate of using soil did not increase as rapidly as the loading The quality of the percolate improved with time after a relatively poor initial period. The results of these studies suggest that the design and operation of soil absorption systems can be improved through use of once-a-week dosing and/or by use of improved pretreatment without imperil-ing ground water quality. W69-02287

A STUDY OF SLUDGE HANDLING AND DISPOSAL

Federal Water Pollut. Control Admin., Washington, D. C.

For primary bibliographic entry see Field 05D. For abstract, see

DEEP-WELL DISPOSAL OF WASTES,

U. S. Geological Survey, Washington, D. C. William R. Walker, and Ronald C. Stewart. ASCE Proc, J Sanit Eng Div, Vol 94, No SA5, Pop 6171, pp 945-968, Oct 1968. 24 p, 5 tab, 68 ref.

Descriptors: *Waste water disposal, *Injection wells, *Legal aspects, *Regulation, Hydrogeology, Permeability, Porosity, Water quality. Identifiers: Compatibility (Injection water).

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Group 5E—Ultimate Disposal of Wastes

Deep-well disposal as a method for pollution control in the U. S. is investigated to ascertain the degree of development of deep-well disposal, and the procedures evolved to control this mode of disposal are reviewed. Only 9 of the 45 states surdisposal are reviewed. Only 9 of the 45 states surveyed expressly prohibit or, as a matter of policy, actively discourage the method of deep-well disposal. Some type of disposal wells are presently in operation in 25 states. The two controlling conditions necessary for an operable deep-well disposal system are a suitable disposal stratum, and a waste physically and chemically campatible with the resident material in the disposal formation. Care must be taken to assure that the various benefits are balanced, and that one aspect is not protected in such a manner as to be to the complete detriment of others. State regulations are sum-marized and tabulated. (Knapp-USGS) W69-02342

WASTE WATER DISPOSAL: SAN JOAQUIN VALLEY, CALIFORNIA,

California Dept. of Water Resources, Sacramento. Elmo W. Huffman.

J Irrig and Drain Div. ASCE. Vol 92, No IR 2, Proc Paper 4847. pp 47-60, June 1966.

Descriptors: *Waste water disposal, California, *Farm wastes, Canals, Watersheds (Basins), *Drainage programs, Saline soils, *Salts, Water quality, Sumps, Consumptive use, Leaching, Drainage water, Evaporation, Transportation. Identifiers: San Joaquin Valley (Calif.).

The California Department of Water Resources determined that the most predictable method for the disposal of agricultural waste waters from the San Joaquin Valley was transportation by canal. Initially the discharge point would be near the outlet of the Sacramento-San Joaquin Delta. Recreation and wildlife features will be incorporated where feasible. Legally, the Bureau of Reclamation must provide disposal for agricultural waste waters from the San Luis Unit Service Area. Quality safeguards will provide assurance that the waste waters will not degrade the receiving waters. Waste water disposal requirements will build up gradually to a peak of about one-half million acre-feet per year by 2020 and then should diminish as present salt concentrations are nearly all leached out and removed. (Affleck-Ariz) W69-02383

5F. Water Treatment and **Quality Alteration**

SUMMARY REPORT ON THE RESIDENTIAL

WATER USE RESEARCH PROJECT, Johns Hopkins Univ., Baltimore, Md., Department of Environmental Engineering Science. F. P. Linaweaver, Jr., John C. Geyer, and Jerome B. Wolff.

Journal of the American Water Works Assoc Vol 59, No 3, March 1967, pp 267-82, 3 Fig, 6 tab, 8

Descriptors: Public utilities, Water rates, *Water demand, *Water consumption, Social values, Risks, Water distribution, Evapotranspiration, Demand, Peak load, Future planning, Forecasting, Identifiers: *Residential water consumption, *Water use patterns, Maximum daily water demand, Design curves.

To determine water use patterns and demand rates in residential areas and the major factors influencing residential water use, master metered, punched type recorder systems were installed to monitor continuously 41 homogeneous residential areas located in various climatic regions throughout the United States. It was found that residential water demands for any duration depend on the number of consumers, their normal domestic or household use, the average irrigable area of their lawns, the rate of evapotranspiration, and the quantity of precipitation. The maximum daily water demand

can be estimated by calculating a value for potential evapotranspiration. In the absence of data, a value of .28 in per day is recommended. The formula and mathematical derivation for these calculations are discussed in some detail. The relationships developed provide an opportunity to evaluate the costs of designing to any level of risk. Several factors other than economic level and climate influence residential water use. Sprinkling demand, metered and flat rate areas, have significant influence on water use. A basis is provided for improved design criteria for water distribution systems, and may make possible the development of more equitable water rate structures. (Gargola-Chicago) W69-02302

COMPREHENSIVE WATER SYSTEM PLAN, Cornell, Howland, Hayes, and Merryfield, Seattle,

For primary bibliographic entry see Field 06A. For abstract, see W69-02303

STABILIZING MANGANESE AND IRON IN WATER, ACCORDING TO THE ILLIG TECHNIQUE (SPANISH),

Pedro J. Caballero. Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 237-242, 1968. 6 p, 6 fig, 3 photo, 2 ref.

Descriptors: *Water quality, *Manganese, *Iron bacteria, *Groundwater, Water treatment, Water pollution control. Identifiers: *Mexico, *Illig process.

The Illig technique was used to stabilize manganese and iron in water. This work was necessary because the groundwater in Mexico carries trace amounts of these elements which eventually leave their oxides to interfere with water meters and the distribution system. The presence of these elements also encourages the development of manganiferrous bacteria of the Cremothrix, Clonothrix, and Gallionella genus, which are objectionable because of their noxious odor and mucilaginous proliferation. These bacteria can be prevented by the addition of sodium hexametaphosphate (Illig process). This compound acts as dispersing agent, in colloidal form, of the iron and manganese oxide particles. (Llaverias-USGS) W69-02351

5G. Water Quality Control

DEPARTMENT OF WATER AND AIR RESOURCES OF NORTH CAROLINA For primary bibliographic entry see Field 06E. For abstract, see W69-02013

PROBLEMS AND PROGRAMS IN WATER POL-LUTION.

Murray Stein. Natural Resources J, Vol 2, No 3, pp 388-415, Dec 1962. 12 p, 2 tab, 6 ref.

Descriptors: Federal-state water rights conflicts, *Water pollution, *Pollution abatement, Water quality, Permits, *State governments, Interstate, Interstate compacts, Interstate rivers, Water law, Administrative agencies, Legislation, Water pollution treatment, Treatment facilities, Standards, Water conservation.

The primary rights and responsibilities for controlling water rest with the states, as shown in the declaration of policy of the Federal Water Pollution Control Act. The modern approach to the problem of pollution is reflected in recent state statutes whose object is to preserve and improve water quality for all users and to accomplish this through an agency that represents all the affected interests in the state. Potentially, one of the most effective techniques for control of water pollution

is a permit system under which discharges of wastes into any waters of the state are prohibited except as permitted by the agency after examination of plans, specifications and other data. The disregard of state boundaries by flowing waters has led to the formulation of interstate compacts for the prevention and control of water pollution. Nine such interstate compacts have received Congressional approval. (R. Smith-Fla) W69-02033

PROBLEMS AND PROGRAMS IN WATER POL-LUTION.

Murray Stein.

Natural Resources J, Vol 2, No 3, pp 388-415, Dec 1962. 17 p, 6 tab, 14 ref.

Descriptors: *Water pollution, Water conservation, Cost sharing, Water demand, Water resources development, *State governments, *Federal government, *Pollution abatement, Standards, Reasonable use, Prior appropriation, Riparian rights, Municipal wastes, Industrial wastes, Water quality, Sewage, Treatment facilities, Interstate compacts.

Although water has been in ample supply up until now, we may be at the dawn of an era when water of usable quality will be this country's most critical natural resource. This article discusses the nature of the water pollution problem, state and interstate programs, and the federal role in water pollution control. It is generally agreed that the objectives of a water policy for the individual states and the nation are: (1) the equitable apportionment of water among often conflicting demands; (2) the improvement of water quality; and (3) the stabilization of water flows and water supply. The concentration of population and industry in urban areas creates serious water pollution problems. Municipal waste treatment processes in use today were designed for the wastes of 40 years ago and no essentially new or more effective process has been developed since. A major need for pollution abatement is to develop new municipal waste treatment processes that will remove much more of the contaminants than is now possible. (Smith-Fla) W69-02036

PLYMOUTH VILLAGE FIRE DIST V WATER POLLUTION COMM'N (WATER POLLUTION

167 A 2d 677-680 (N H 1961).

Descriptors: *New Hampshire, *Legislation, Cities, Sewage, Industrial wastes, Municipal wastes, Water law, Water pollution, Pollution abatement, *Water pollution control, Water quality, State govern-ments, Local governments, Waste disposal, Sewage disposal, Sewage treatment, Water pollution sources.

Plaintiff appealed from a decision of the Water Pollution Commission denying a further extension of time in which to comply with an order to abate the pollution caused by the discharge of raw sewage or inadequately treated sewage from the plaintiff town's sewerage system. The Commission in-dicated that an extension would be granted only if the plaintiff took positive action toward making final plans for a disposal plant which would solve the waste treatment needs of the entire community. The court found that the plaintiff admittedly had no definite plans for the erection of a disposal plant and that the plaintiff had no present intention of taking any action to meet the pollution control requirements. The court dismissed the appeal and held that the Commission had not exceeded its powers in attaching a condition to the granting of the extension. (Smith-Fla) W69-02050

WATER SUPPLY QUALITY CONTROL. For primary bibliographic entry see Field 06E. For abstract, see . W69-02060

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Water Quality Control—Group 5G

THE ADSORPTION AND DEGRADATION OF INSECTICIDES BY LAKE SEDIMENTS, Wisconsin Univ., Madison.

L. W. Newland, and G. Chesters

PhD Thesis, University of Wisconsin Library, Madison, Wisconsin. Project OWRR-B-016-WIS.

Descriptors: *Gamma-BHC, *Degradation, *Adsorption, Isomerization, *Parathion, Anaerobic, Aerobic, 1st-order kinetics, *Hydrolysis, Alkalicatalysis, Adsorption-catalysis.

Identifiers: Simulated lake impoundments, *Insecticide pollution, *Adsorption by lake sediments, *Degradation in lakes.

For extraction of gamma-BHC from a lake sediment a 41:59 hexane:acetone mexture was used. Best recovery was obtained by shaking for 6 hours and repeating the procedure. The sample was partitioned into hexane by addition of water and analyzed directly by GLC. Adsorption of gamma-BHC on 8 sediments was affected by sediment and gamma-BHC concentrations, and organic matter and clay contents. As molecule is neutral, van der Waals and H bonding are likely adsorption mechanisms. Degradation of gamma-BHC in simulated aerobic and anaerobic impoundments showed anaerobic degradation was more rapid. In an aero-bic system 15% added gamma-BHC was degraded in 2100 hours and alpha-BHC formed. In an anaerobic system, 90% was degraded in 2100 hours to alpha and delta forms. Thermodynamic stabilities are gamma-<alpha-<delta-
beta-BHC.
Volatilization of gamma- and alpha-BHC curtailed isomerism to stable forms, but anaerobically some delta was formed. Isomerization leads to detoxification. Parathion hydrolyzes by 1st order kinetics. In aqueous systems t-half values were 2150, 3250 and 138 hours at pH2, 7 and 10. In sediments degradation is more rapid than predicted from aqueous systems and is catalyzed by adsorption. T-half values were 258 and 220 hours in nonsterile and sterile samples. Hydrolysis occurs at POC bond attached to phenyl ring. W69-02074

PAPILLION CREEK AND TRIBUTARIES. NEBRASKA.

Corps of Engineers, Washington, D. C. For primary bibliographic entry see Field 08A. For abstract, see . W69-02282

ANALYSIS OF FEDERAL WATER POLLUTION CONTROL LEGISLATION, 1948-1966, Cornell Univ., Ithaca, New York. Water Resources

Leonard B. Dworsky.

Journal of the American Water Works Assoc., Vol. 59, No. 6, June 1967, pp 651-668, 14 ref.

Descriptors: *Water pollution abatement, Political aspects, Federal project policy, *Legal aspects, State jurisdiction, State governments, Research and development, Regulation, Costs, Financing, *Water, management, Administration, desirable projects of the project policy *Water management, Administrative decisions,

Inter-agency cooperation.
Identifiers: Water Quality Act of 1965, Clear
Water Restoration Act of 1966, Federal Water Pollution Control Act, Guidelines.

An attempt is made to set in perspective the general principles of water pollution control legislation. Until the late '30's the national policy was one of non-interference; states were given con trol over their own pollution. In 1946 a new major series of actions began, outlining strong federal action. The new basic policy reiterated the authority of Congress to exercise jurisdiction over the con-trol of pollution. Primary responsibility for the pro-gram shifted from certain federal departments, and today rests with the Department of the Interior. The water pollution control legislation of 1948 has resulted today in the return to the idea of adoption of a comprehensive pollution control plan by the states with the provision that federal action can be taken in face of state inaction. Prior to 1961 federal water resource development agencies were not provided with general authority to store and regulate water but new amendments of 1966 have allowed them to participate in regional planning with the states. Other sections of the new water pollution legislations are also discussed: (1) interstate cooperation and uniform laws, (2) research, investigations, training and information, (3) grants for research and development, (4) grants for water pollution control programs, (5) grants for construction, and (6) the Water Pollution Control Advisory Board. Enforcement measures against pollution of interstate navigable waterways are discussed through changes that have taken place. Abatement action is reviewed with the relevant section of the Act discussed, and related legislation on regulaexecutive orders, Secretary's Guidelines and some of the more important ones illustrated. (Gargola-Chicago) W69-02312

WATER-QUALITY CONTROLS THE PROBLEMS AND THE SOLUTIONS.

Burton J. Gindler.

In R. E. Clark's Waters and Water Rights, Vol. 3 Water Pollution and Quality Controls, 1967, pp 1-

Descriptors: *Water quality control, *Water pollution, Chemical oxygen demand, Color, Turbidity, Physical properties, Chemical properties, Taste, *Water properties, Dissolved oxygen, Acidity, Alkalinity, Temperature, Odor, Pollutants, *Legisla-

The chapter begins with a discussion as to the scope of this volume. Some definitions are then given, and water quality and pollution are distinguished. The physical and chemical properties affecting water quality, such as: dissolved oxygen, biochemical oxygen demand, acidity and alkalinity of water, solids in water, turbidity, color, tempera ture, taste and odor, and living organisms in water are then discussed. This is followed by a description of the natural quality of water. Sources and means of water pollution are next discussed leading into an evaluation of water quality. The chapter is concluded with a perspective on water-quality problems and a look into the history of water-quality control laws. (Watson-Fla) W69-02313

WATER-QUALITY CONTROLS ENFORCEA-BLE IN COURTS UNDER STATE LAW,

Burton J. Gindler.

In R. E. Clark's Waters and Water Rights, Vol 3 Water Pollution and Quality Controls, 1967, pp 33-

Descriptors: *Riparian rights, *Water pollution, Reasonable use, Water quality, Watercourses (Legal), Lakes, Surface waters, Marshes, *Invasion, Wastes, Sewage disposal, Streams, Dams, Backwater, Damages, Subsurface waters, Water law, State governments.

This introductory section of Chapter 13, Water-Quality Controls Enforceable in Courts Under State Law, first gives the general scope of the chapter. Then definitions of the terms watercourses, lakes, subterranean waters, surface waters, liability, and harm are given from the Restatement of Torts. There are two general theories upon which a person whose property is harmed by water pollution might recover: interference with land and private nuisance of impairing water control. Interference with land may be through trespass or private nuisance. Trespass involves the deposit of material upon the plaintiff's land which constitutes an interference with the exclusive possession and physical condition of the land. Private nuisance which results in interference with the private use and enjoyment of the land may result from objectionable odors in the water. Private nuisance impairing water quality suits are based on the plaintiff's riparian rights to the use of the water. The reasonableness of the use the defendant is making of the water is a basic issue, and substantial harm is

always required. A showing of negligent, reckless or ultra-hazardous conduct by the defendant is only required when the invasion is unintentional. (Wat-W69-02314

HYDROLOGIC RELATIONSHIPS AND WATER

Burton J. Gindler. In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp 124-133.

Descriptors: *Hydrologic cycle, *Water quality, Streams, Water pollution, *Watersheds (Basins), Lakes, Watercourses (Legal), Surface runoff, Channels, Subsurface waters, Percolating water, Riparian rights, Priorities, Competing uses, Reasonable uses.

Water pollution law now in existence in most jurisdictions ignores the hydrologic cycle and other scientific knowledge regarding the relationship and movement of water. For effective water quality control, water law should be established according to natural basins rather than individual lakes and streams. Suggested ways in which water quality and quantity can be legally controlled on a basin system rather than individual waterways are set out. The legal obligations owed by the residents of the basin to their neighbors should be determined by their relative positions on the hydrologic cycle. (Watson-Fla) W69-02320

JUDICIAL REMEDIES AGAINST POLLUTION, For primary bibliographic entry see Field 06E. For abstract, see

W69-02322

DEFENSES IN WATER-POLLUTION LITIGA-

For primary bibliographic entry see Field 06E. For abstract, see . W69-02323

CONTROLLING INDUSTRIAL WATER POLLU-TION: COLOR THE PROBLEM GREEN,

Iowa Univ. Law School. N. William Hines.

Boston College Ind and Com L Rev, Vol 9, No 3, pp 553-611, spring 1968. 59 p, 277 ref.

Descriptors: Water purification, Water pollution, Water pollution sources, Effluents, *Industrial wastes, Legislation, *Pollution abatement, *Water quality, Thermal pollution, Water pollution control, Quality control, Acid mine water, *Standards, Federal government, State governments, Local governments, Cities, Administrative agencies.

Economic factors, not a lack of technical knowhow, are the principle deterrant to cleaning up pol-lution. Facts and figures are related showing that industry is the worst polluter of our water supply, because its investment in treatment facilities yields an economic loss. Pollution from various industries is discussed. Federal water quality control legislation is discussed with reference to an emerging national water quality policy. This policy seems aimed at positive efforts to enchance water quality. The legislative provisions are outlined. The major portion of the article is devoted to a discussion of possible means of generating the huge capital investment necessary for pollution control. Raw economics does not provide adequate incentives for pollution abatement. Therefore, public regulation is required. Federal, interstate, state and local enforcement are discussed. The use of water quality standards is explained. Federal financial assistance programs include Small Business Administration grants and municipal waste facilities construction grants. Proposed incentive programs, distinguished from assistance programs, include direct payments and grants, special tax treatment

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G-Water Quality Control

and loans. Effluent charges would work to set economic forces in motion by exacting a charge from industries for the damage they do to the water supply. It is concluded that one of these programs or a combination thereof should be implemented soon to help solve the serious industrial pollution problem. (Williams-Fla) W69-02331

COAL MINING EFFECT ON BUSSERON CREEK WATERSHED, SULLIVAN COUNTY, INDIANA.

Indiana Univ., Bloomington. For primary bibliographic entry see Field 05B. For abstract, see . W69-02341

06. WATER RESOURCES PLANNING

6A. Techniques **OF Planning**

COMPREHENSIVE WATER SYSTEM PLAN, Cornell, Howland, Hayes, and Merryfield, Seattle, Washington.

Holly Cornell.

Journal of the American Water Works Assoc., Vol 60, No 2, February, 1966, pp 125-129.

Descriptors: Industrial demand, Water supply, Water demand, Administrative decisions, *Adoption of practices, Future planning, Forecasting, *Estimation, *Comprehensive planning, Project planning, Water supply, Water demand, Land use. Identifiers: *Water system development.

The current emphasis on area-wide planning of all public facilities includes the need for the development of comprehensive plans for water systems. The primary purpose of the plan is to determine the facilities required to serve a given area during a given period. The overall planning for an area which should be completed and available before the water system planning starts should include: (1) the extent of the area to be served, (2) the land use and development plan for this area, (3) an estimate of the rate of growth, and (4) an industrial development forecast. Once the overall planning information has been assembled, the next step is to forecast the need for water. Accuracy of predictions for future water demand is difficult, especially for industrial needs. Methods of discovering future demand characteristics could be developed on other basis, but the key factor is that the results be related to the system plan so that it remains flexible. This same flexibility must be present in plans for the supply system development where the availability of sources of supply is difficult to estimate. The comprehensive plan needs to be presented in a concise fashion so that it can be readily understood and referred to. But beside this it must be flexible, constantly reviewed, and updated. W69-02303

6B. Evaluation Process

FINANCIAL MANAGEMENT OF A WATER UTILITY,
City Water Board, San Antonio, Texas.

Stuart H. Bogue.

Journal of the American Water Works Assoc, Vol. 60, No 3, March 1968, pp 267-273.

Descriptors: *Financing, Public utilities, Capital, Investment, Water management, Budgeting, Adoption of practices, *Administrative decisions, Com-prehensive plan, Long-term planning, Schort-term planning, Scheduling, Municipal governments, As-

Identifiers: Guidelines, *Water budget, Algonac (Mich), Oak Park (Mich), Revenue bonds.

A well managed water utility needs revenue to meet operating and maintenance expenses, support an adequate depreciation fund, meet all interest charges, and amortize outstanding indebtedness Funds are also necessary to provide a surplus to pay for ordinary capital additions and emergencies, and to attract investment capital for major expansion. Two types of bonds are used to finance municipal projects, general obligation bonds, and revenue bonds. Each of these have advantages, and the use of either may be dictated by the particular situation. New system financing possibilities are discussed and the problem of special assessments considered. Illustrations of inefficient financial management are given through examples of two smaller communities. To aid these and other communities in developing efficient financial systems for water utilities, a program of development and budgeting is outlined. Briefly stated the points are: (1) development of a comprehensive plan that encompasses every aspect of the water departments potential for physical and fiscal development, (2) long-range plans that project operating needs, (3) short-range plans that bring into focus the need for limited scope improvements, (4) long-term fiscal plans. To maintain the planning effort a realistic budget should be established, including: (1) a system for organization, (2) an accounting system, (3) a performance data system, (4) a scheduled budget, and (5) a clear departmental framework within which budgeting responsibilities are assigned. (Gargola-Chicago) W69-02301

THE PLACE OF MULTIPURPOSE RESER-VOIRS IN WATER SUPPLY PLANNING. Public Health Service, Washington, DC.

Robert W. Haywood, Jr.

Journal of the American Water Works Assoc., Vol. 55, No. 3, March 1963, pp 263-266, 1 ref.

Descriptors: Multi-purpose planning, Water supply, Legislation, Municipal supply, Future planning, *Storage, Recreation, Industrial demand, Forecasting, *Repayment contracts.
Identifiers: Water Supply Act of 1958, Multi-purpose reservoirs, Revenue requirements.

A particularly important source of assistance for providing future water supply is the Water Supply Act of 1958. This Act makes possible storage in multipurpose reservoirs for anticipated municipal and industrial water demands. Although the advantages of this Act are many, certain errors should be avoided when planning the construction of multipurpose reservoirs with a substantial storage space for future demands. Too often there has not been recognition of the need for repayment of the costs to storage with a proportionate share of the cost of operating and maintaining such facilities. Overestimation of future recreation, municipal, and industrial water demand causes error. Careful and accurate study must be made to predict future needs and demands, so that they coincide to a reasonable degree, and revenue requirements are fulfilled. Care must be exercised on taking advantage of opportunities provided by the Water Supply Act so that too much or too little storage is not bought. Errors in either direction can be quite costly. (Gargola-Chicago)

EVALUATION OF INVESTMENTS IN WATER

RESOURCE MANAGEMENT, Wisconsin Univ, Madison, Wisconsin. Water Resources Center. Irving K. Fox.

Journal of the American Water Works Assoc., Vol. 59, No. 8, August 1967, pp 913-918.

Descriptors: *Investment, Economic evaluation, Intangible benefits, Political aspects, Water resource development, Repayment contracts, Motivation, Project planning, *Water management, *Administrative decisions, Water policy, *Social values.

Identifiers: Range of choice, Flood Control Act, Cost sharing policies, Redistribution of income.

There are three fundamental limitations for any effort at technical evaluation of public investments: (1) intangible benefits and costs, (2) evaluation of redistribution of income, and (3) biased evaluations, reflecting different standards. There is considerable evidence to indicate that sight has been lost of the role of technical evaluation. The purpose of technical analysis is to serve the political process as effectively as possible. The public should make decisions regarding value judgments in water resource development. For this reason, all alternatives should be presented to them. There are difficulties, however in doing this: (1) presentation of the range of choice in a form easily understood by laymen is difficult, (2) individual agencies do not have the expertise, the authority, or the tradition to consider the full range of alternatives, (3) existing repayment of policies discourage the consideration of alternatives, and (4) public agencies, for reasons discussed, have a motivation not to present the range of choice. To aid in the solution of these problems four suggestions are presented: (1) experimentation and study should be undertaken by both planning agencies and research institutions to develop techniques for presenting the range of choice, (2) in training of engineers and economists the responsibility of a planner in a democratic society should be made clear, (3) patterns of organization and policy should be reexamined to determine necessary changes, and (4) a way should be developed for creating pressures on planning and administrative agencies which reflect the interests of all the concerned parties. (Gargola-Chicago) W69-02311

SOME ECONOMIC ASPECTS OF WATER-QUALITY ENHANCEMENT, Baltelle Memorial Institute, Columbus, Ohio.

Henry R. Hamilton.

American Institute of Chemical Engineers, St. Louis, Mo. Feb. 18-21, 1968, pp 23, fig 1.

Descriptors: Water pollution, *Water quality, *Resource allocation, Mathematical models, *Resource allocation, Mathema Aesthetics, *Environmental effects.

The author analyzes the theoretical basis for evaluating water quality enhancement. The benefits he considers to be primarily recreational and aesthetic. Although he defines them as intangibles; he recognizes that recreation benefits can be evaluated, and he considers that aesthetics of water quality, when reflected in value of home sites and industrial areas, could be evaluated by 'common sense plus economic analysis'. For actual evaluation he suggests a model with population sector, economic activity sector, and water sector, includ-ing 'feedback' relationships. He concludes that despite billions of dollars to be spent to enhance water quality, little attempt has been made to come to grips with measuring the benefits to be derived. Perhaps our allocations of resources would be different if we evaluated water quality benefits. (Whipple-Rutgers) W69-02399

6C. Cost Allocation, Cost Sharing. Pricing/Repayment

WATER POLLUTION -- 1968, PART 1. For primary bibliographic entry see Field 05D. For abstract, see. W69-02063

MUNICIPAL SEWER SERVICE CHARGES. For primary bibliographic entry see Field 05D. For abstract, see. W69-02064

MODERN SEWER-SERVICE CHARGES, PART I - WHY CITIES NEED THEM.

For primary bibliographic entry see Field 05D. For abstract, see

W69-02065

MODERN SEWER-SERVICE CHARGES, PART II - SOME TYPICAL RATES.

For primary bibliographic entry see Field 05D. For abstract, see . W69-02066

WATER POLLUTION -- 1968 PART I -- (MODERN SEWER-SERVICE CHARGES, PART 3, METERED VS FLAT).

For primary bibliographic entry see Field 05D. For abstract, see . W69-02067

WATER POLLUTION -- 1968, PART 1 -- (MODERN SEWER-SERVICE CHARGES, PART 4, THAT ELUSIVE PERCENTAGE). For primary bibliographic entry see Field 05D.

For abstract, see . W69-02068

WATER POLLUTION -- 1968, PART I -- (MODERN SEWER-SERVICE CHARGES, PART 5, PENALTIES HURT YOUR UTILITIES) For primary bibliographic entry see Field 05D.

For abstract, see . W69-02069

SPECIAL CONSIDERATIONS IN DESIGN OF WATER RATES,

Brown and Caldwell, San Marino, California

John C. Luther.
Journal of the American Water Works Assoc., Vol 55, No 3, March 1963, pp 325-335, 3 tab, 2 ref.

Descriptors: Public utilities, Municipal supply, Revenue, Pricing, *Adoption of practice, Adminis-tration, Operating costs, Depreciation, Investment, chedules, *Water rates, Demand, Costs.

Identifiers: *Water rate design, Base year, Block rates. Zone rates. Demand rates

Publicly owned utilities normally include their cost of participation in extensions as part of revenue requirements. For investor-owned utilities, the effect in revenue requirements is reflected in depreciation expense, income taxes, and return on investment. Depreciation expense as revenue requirement also has a different significance depending on ownership. Before any study is made of future revenue requirements, it is essential to examine current costs and revenues for the establishment of a base year from which projections can be made. Steps through which this can be carried out are discussed. Operating ratios for public and investor-owned utilities are compared. Similarity in revenue and operating expenses for both cases is recognized and suggestions for attaining uniformity in accounting practices put forth. Application of principles of pricing for determining proper rates to produce desired income is examined. Typical rate schedules, block rates, zone rates, and demand rates are considered for establishment of proper practices. The separation of commodity costs into pure commodity costs and demand costs is discussed. General price theory has only a limited application in design of water rates. Fundamental pricing concepts should be followed in establishment of blocks and ranges of rates. (Gargola-

Chicago) W69-02304

REVIEW OF RATEMAKING THEORIES, Alvord, Burdick, and Howson, Chicago, Illinois. Louis R. Howson.

Journal of the American Water Works Assoc., Vol. 58, No. 7, July 1966, p 849-855.

Descriptors: Water supply, Water consumption, *Water rates, Standards, *Water management, Operating costs, Financing, Long-range planning, Capital, Maintenance costs.

Identifiers: Revenue, *Ratemaking, schedules.

Ratemaking should be preceded by long-range planning and study of present and future water requirements coordinated with a sound program of construction, financial planning for capital and its fixed charges, and operating and maintenance expenditures. Gross revenue requirements over the near future period, during which the rates will be collected must be carefully estimated and used in the allocation among consumers. The prime requisite of ratemaking is that the total revenue requirements be equitably apportioned between all classes of consumers. Rate schedules should have few steps and be based on the same principles for sale inside or outside the core city. U. S. practice, which requires the users to build and pay for water facilities by rates has produced the best water supplies in the world that make more and better water available to all classes. (Gargola-Chicago) W69-02307

THE PLACE OF MULTIPURPOSE RESER-VOIRS IN WATER SUPPLY PLANNING, Public Health Service, Washington, DC For primary bibliographic entry see Field 06B.

For abstract, see W69-02308

NATIONAL PLAN TO SUPPLY DRINKING WATER TO URBAN DISTRICTS, 1966-1970. (SPANISH).

For primary bibliographic entry see Field 03D. For abstract, see . W69-02366

6D. Water Demand

SUMMARY REPORT ON THE RESIDENTIAL WATER USE RESEARCH PROJECT,

Johns Hopkins Univ., Baltimore, Md., Department of Environmental Engineering Science For primary bibliographic entry see Field 05F. For abstract, see W69-02302

METHOD FOR ESTIMATING FUTURE DISTRIBUTION SYSTEM DEMAND.

John A. Strand and Assocs. Inc., Madison, Wiscon-

John A. Strand.

Journal of the American Water Works Assoc., Vol. 58, No. 5, May 1966, pp 521-526.

Descriptors: Methodology, *Water demand, Storage capacity, Pumped storage, Water distribution, Long-term planning, Adoption of practices, *Forecasting, Estimating, *Decision making. Identifiers: Distribution system demand, Meters.

A method is outlined for estimating future maximum water demands of a city along with a method of determining capacities needed to meet those demands. The method of estimating future demand is based on the premise that, except for large industrial demands, the future demands on a maximum day, and the distribution of the demands on that day, can be most accurately determined by extending past experience data. Each component of future demand is estimated by several methods, a figure is set for each component, and the total demand established by adding the components. Study of each component separately permits detection of any change in the rate of growth of that portion of the total demand. Use of several methods to estimate each component permits the use of averages that minimize the effect of unusual past performance, errors in the data, and human inaccura-cies. Estimating capacity is discussed, considering the significant factors of pump and storage requirements. (Gargola-Chicago) W69-02306

RELATIONSHIP OF DOMESTIC WATER USE TO ASSESSED VALUATION WITH SELECTED DEMOGRAPHIC AND SOCIO-ECONOMIC VARIABLES, Illinois Univ., Urbana, Illinois. Department of Hy-

giene and Public Health and State Water Section, Urbana, Illinois.

Dorothy F. Dunn, and Thurston E. Larson.

Journal of the American Water Works Assoc., Vol. 55, No. 4, April 1963, pp 441-451, 2 fig, 3 tab, 18

Descriptors: *Methodology, *Water use, Water users, *Consumption, Social aspects, Behavior, Attitudes, Municipal water suppyl assessments, Parameters.

Identifiers: Kankakee (Illinois), Demographic variables, Socio-economic variables.

Literature on domestic water use includes only a few of the many variables which have some influence on domestic water demand. A review of past studies is given, indicating the emphasis of particular studies. In this report there were two aims in analyzing the factors which may cause variation in water use: (1) to learn the extent of uniformity in water use and (2) to learn of differences in water use by special group classifications. The method of procedure is outlined and general background information given. Simple correlations with socioeconomic characteristics showed the maximum month household water use correlated best with occupation of principal wage earner. The second most important parameter was number in the household. These results suggest demographic and economic variables that may influence the water use patterns of households. This was a study of single dwelling units, in a particular city, Kankakee, and the findings may be similar but not specific, to other areas. (Gargola-Chicago) W69-02309

AUSTRALIAN AND AMERICAN WATER ALLOCATION SYSTEMS COMPARED,

For primary bibliographic entry see Field 06E. For abstract, see . W69-02329

WATER-OUR SECOND MOST IMPORTANT NATURAL RESOURCE,

Rensselaer Polytechnic Institute. For primary bibliographic entry see Field 02A. For abstract, see . W69-02332

IRRIGATION IN KANSAS.

Kansas Water Resources Board, Topeka.

Kans Water Resources Board Rep No 16 (e), 23 p, Sept 1967. 31 fig, 104 map, 34 ref.

Descriptors: *Data collections, *Irrigation water, *Kansas, Irrigation efficiency, Water development, Irrigation practices, Water yield, Water wells, Mater demand, Water quality, Water levels, Surface waters, Groundwater, Planning.

Identifiers: *Potential irrigation development, Ir-

Data on irrigation in Kansas, including the amounts of surface water and groundwater used, well yields, water quality, saturated thickness of uncon-solidated deposits, the amount of land suitable for irrigation, projected irrigation requirements, groundwater availability, and surface water availability, are summarized for each county. Because of profitability, irrigation is expected to increase in Kansas. At present withdrawal rates, there is a large groundwater overdraft. Water conservation measures are necessary and are being developed and put into use. These include evaporation control, more careful application of water, and studies of artificial recharge methods. Surface water availability is seasonal and erratic from year to year. To use it efficiently, much more surface storage or aquifer recharge must be developed. (Knapp-USGS) W69-02348

Field 06-WATER RESOURCES PLANNING

Group 6D-Water Demand

A SAMPLE DESIGN FOR INVESTIGATING THE EFFECTS OF STREAM POLLUTION ON WATER BASED RECREATION EXPENDI-TURES.

Pennsylvania State Univ., Institute for Research on Land and Water Resources.

For primary bibliographic entry see Field 05C. For abstract, see W69-02357

MANAGEMENT: A KEY TO IRRIGATION EF-

Water Conservation Laboratory, Phoenix, Arizona. Leonard J. Erie.

J. Irrig and Drain Div ASCE, Vol 94, No IR3, Proc Paper No 6107 pp 285-293, September 1968. 9 p, 2 fig, 4 tab.

Descriptors: *Irrigation efficiency, *Water loss, Planting management, Irrigation practices, *Water conservation, Water management (Applied), Water delivery, *Consumptive use, Arid climates, Surface waters, Seepage, Sprinkler irrigation, Farm management, Application methods, *Water con-

Identifiers: *Irrigation agriculture.

Irrigated agriculture accounts for most of the water consumptively used. This is particularly true in the arid southwest. Losses of irrigation water that occur in its movement from source to ultimate use are described, and some unavoidable water losses in water management are identified. Various cultural practices, irrigation systems and consumptive use data were discussed in relation to water conservation. (Affleck-Ariz) W69-02386

COMPETITION FOR RECREATION WATER IN CALIFORNIA,

Amalio Gomez, and Dale A. Crane.
J. Irrig and Drain Div, ASCE. Vol 94, No IR3, Proc. Paper 6109. pp 295-307, September 1968. 13 p, 2 fig, 3 tab.

Descriptors: *Recreation demand. Reservoirs. Water storage, Water loss, Water requirements, Arid climates, *Competition, *Multiple purpose reservoirs, California, Recreation facilities, Water resources development, Costs.

Water-oriented recreation has experienced tre-mendous growth in recent years. This has brought about great demand for minimum recreation pools and adequate recreation facilities at reservoir projects. Water pools for recreation require acquisition of water to fill them initially and to compensate for added evaporation losses later. This difficult problem was satisfactorily solved in four federal reservoirs in a water-deficient area in California. Procedure used entailed a high degree of cooperation by water users, public at large, and construction agency. Required water for recreation was estimated at less than one half of one percent of natural river flows. Total cost, including storage, water, recreation facilities, and maintenance and operation was estimated at \$0.30 per recreation day. (Affleck-Ariz) W69-02388

6E. Water Law and Institutions

KISTLER V WATSON (IMPROPER RESTRIC-TION OF STREAM FLOW).

For primary bibliographic entry see Field 04A For abstract, see . W69-02001

MONTELIOUS V ELSEA (WITHDRAWAL FOR IRRIGATION). 161 N E 2d 675-680 (C C Pl Ohio 1959).

Descriptors: *Ohio, Civil law, Judicial decisions, *Riparian rights, Competing uses, Natural use, *Reasonable use, Riparian waters, *Irrigation, Flow Diversion, Relative rights, Withdrawal

Plaintiff and defendant owned contiguous tracts of farmland. Defendant was an upper riparian owner, and plaintiff was a lower riparian owner on a creek that both used to water livestock. Defendant occasionally used a pump to divert some waters from the creek to his farmland for irrigation purposes. Plaintiff sought an injunction to prevent defendant from thus diverting the waters. The court denied the request, holding that such use by defendant was not unreasonable. A riparian owner has a right to make reasonable use of a stream for the purpose of irrigation, such reasonableness to be determined on an individual basis and depending upon the particular circumstances involved. In this instance, at the times the defendant used his irrigation pump, the creek did not dry up nor was the plaintiff deprived of the water needed for his livestock. The right of a riparian owner to make reasonable use of a stream for the purpose of irrigation is a property right and is entitled to protection. (Scott-Fla) W69-02003

BEHRENS V SCHARRINGHAUSEN (REASONA-**BLE USE OF PERCOLATING WATERS).** 22 111 App 2d 326, 161 N E 2d 44-46 (1959).

Descriptors: *Illinois, Judicial decisions, Pumping. Drainage systems, *Percolating water, Percolation, Subsurface runoff, Diffusion, *Reasonable use, Water table, Water supply, Wells, *Subsurface

Plaintiffs owned a farm, for which they obtained water from sources beneath and upon their lands. Defendants operate a sand and gravel pit adjacent to plaintiff's farm. Subsurface waters started to seep into the defendant's gravel pit in 1956, and defendants installed two pumps to remove it. The excess water is pumped to the surface and discharged into a stream that flows through the plaintiffs' lands. Plaintiffs claimed that the use of the pumps lowered the water table, forcing them to sink deeper wells and use larger pumps to obtain the amounts of water their farm required, and asked that the court grant a permanent injunction to restrain defendants' from continuing the pumping. The court held that defendants had not irreparably injured the plaintiffs, and denied the injunction. The court also discussed the two basic rules of law governing 'percolating water' disputes. The English rule permitted a landowner to dig below the surface of his land and apply all that is found there to his own purposes, without any restrictions. This has been rejected in many areas in favor of what is generally known as the American doctrine of reasonable use', which limits the right of the landowner to such amount of the percolating waters under his lands as may be necessary for some useful purpose. The latter doctrine would probably be folowed by this court (Illinois). (Scott-Fla) W69-02004

CUTLIFF V DENSMORE (OWNERSHIP OF ACCRETED LAND). 354 Mich 586, 93 N W 2d 307-311 (1958).

Descriptors: *Michigan, Civil law, Judicial deci-

sions, *Accretion (Legal aspects), *Boundaries (Property), *Boundary disputes, Shores, Lake shores, Navigable waters, Riparian waters, Mean-

Four lots on a bay abutted each other in the shape of a block letter 'L' with lot one at the top, lot two below, lot three at the base, and lot four forming the horizontal portion of the 'L'. Each lot had some varying portion of the shoreline as one of its boundary lines. Since the original plat was made land formed by accretion between the present shoreline and lots three and four, with some amount of recession to lots one and two. The shoreline then ran almost diagonally from the northern tip of the 'L' straight to the eastern-most end of the base of the 'L'. A boundary dispute arose over ownership of the accretion land between the owners of lots three and four. The court held that where property abuts a shoreline, that shoreline as represented on government plats by a meander line is the boundary of the property notwithstanding its subsequent advancement or recession. The court affirmed the decision of the lower court which held that the present shoreline and accreted land should be divided between the four lots in the same proportion that each lot bore to the original shoreline as shown by the meander line on the original government at. (Scott-Fla) W69-02005

WILCOX V PINNEY (TITLE TO ACCRETION). 98 N W 2d 720-726 (Iowa 1959).

Descriptors: *Iowa, Judicial decisions, Ownership of beds, Riparian land, *Boundaries (Property), Avulsion, Bank erosion, Navigable rivers, *Accretion (Legal aspects), Erosion, High water mark.

In this suit to quiet title, plaintiff claimed absolute and unqualified legal ownership of a certain real property. The record title to this property has been in plaintiff and his predecessors for over one hundred years. At the time of the original government plat in about 1850 a river hugged the western side of the tract in question. This river moved east about seventy five years later, and about ten years after this returned to its former and present position. The court found that in making these changes, the river slowly eroded away all the intervening land, and then by accretion rebuilt it. At one time during the erosion little or none of the land in question was above the high water mark. Plaintiff's claim of title was erased, because the eroded land was no longer subject to identification; in such cases, the title to the land so occupied by the bed of the river passes from the owner of the land to the state. The court held that the counter-claimants had title to the land by virtue of their ownership of the land along the east high bank of the river, to which the accreted land attached. (Scott-Fla) W69-02006

WISE MANAGEMENT OF NORTH CAROLINA WATER RESOURCES THROUGH LAW (AN ORIENTATION BROCHURE).

North Carolina Dept of Water Resources, Orientation Brochure Vol 1, Aug 1966, 114 pp.

Descriptors: *North Carolina, *Administration, *Water resources development, Regulation, State governments, Competing uses, Research and development, Political aspects, Legislation, *Water conservation, Groundwater, Surface water, Administrative agencies.
Identifiers: *Quantity control.

This study was authorized by the 1965 North Carolina General Assembly. Its aim was to solicit a response to the Board of Water Resources' request for advice from all sources in regarding methods and policies for safeguarding and developing the state's water resources. Problems of water quantity were the major concern of the study. The Board was convinced that its existing powers were inadequate to meet the problems facing it. Chapter 1 outlines the history of water resources research in N C and gives the current status of programs and agencies concerned with water resources. Chapter 2 discusses surface water problems, ground water problems and their interrelationship. The specific problem which prompted the Board to seek addi-tional powers, which revolved around a proposal to lease two river bottoms to phosphate mining com-panies, is discussed. This chapter attempts to set out the reasons why N C has a need for additional regulation of water resources. Chapter 3 explores legislative developments in other states with regard to water quantity control. Chapter 4 sets out possible courses of action and concludes that some significant regulatory legislation is needed. A list of 33 references is included. (Williams-Fla) W69-02007

Water Law and Institutions—Group 6E

RELATIVE RIPARIAN OR LITTORAL RIGHTS RESPECTING THE REMOVAL OF WATER FROM A NATURAL, PRIVATE, NON-NAVIGA-BLE LAKE, C. C. Marvel.

C. C. Marvel. 54 ALR 2d 1450-1454.

Descriptors: Riparian rights, Riparian land, Judicial decisions, Ownership of beds, *Reasonable use, *Lakes, *Natural flow doctrine, Competing uses, Legal aspects, Water law, *Relative rights, Water utilization, Non-navigable waters, Ponds, Water levels, Irrigation.

Conflicts between riparian owners having equal legal rights by virtue or their riparian ownership alone are discussed. Specifically the right of one owner to remove water from a private, non-navigable, natural lake or pond is balanced against the right of another owner to have the level of the water maintained. The key terms used are defined and explained. There are two general theories con-cerning riparian rights applicable to the narrow factual situation posed by this annotation, the natural flow and the reasonable use theories. Under the natural flow theory, a riparian owner using the water is presumed to have the right to use the water as long as such use does not unreasonably interfere with the use of another owner. Cases are discussed to illustrate the extent to which the application of the different theories make a practical difference in the result. (Smith-Fla) W69-02008

APPORTIONMENT OF AREA OF RIVER BETWEEN RIPARIAN TRACTS FRONTING ON SAME BANK, C. T. Foster.

65 ALR 2d 143-194 52 p, 27 ref.

Descriptors: Adoption of practices, *Distribution patterns, Water distribution (Applied), Boundaries (Property), *Boundary disputes, Civil law, *Equitable apportionment, Judicial decisions, Legal aspects, Legislation, Ownership of beds, Relative rights, Riparian land, *Riparian rights, Riparian water, Water law, Rivers, Local governments, State governments.

An annotation is presented of the law in various states covering the question: In the absence of agreement or controlling specifications, how will the area of a river or river bed be apportioned between two or more tracts of riparian land lying along the same side of the river. The annotation is concerned with methods of projecting boundary side lines out from the bank of the river. It is concluded that the most generally recognized over-all rule is that courts should give riparian rights to the river on the basis of the proportionate extent of river frontage. The effect of provisions of local statutes is discussed briefly. Specific rules, methods and determinations are analyzed in detail. Emphasis is given to the interpretation of these formulasis is given to the interpretation of these formula-tions in various states. Among the methods discussed are perpendicular projection methods using the thread of the stream, the course of the river, the line of the channel, or the line of the shore as a basis. Projection in the direction of the channel, and special problems involved with curved channels or shorelines are also discussed. Pfeiffer-Fla) W69-02009

WATER RIGHTS, NAVIGABLE STREAMS, ETC.

85 Ga Code Ann secs 85-1301 to 85-1312 (1967).

Descriptors: *Georgia, Legislation, Navigation, *Ownership of beds, *Riparian rights, Navigable waters, Non-navigable waters, Streambeds, Boundaries (Property), Dams, Ditches, *Tidal water, Water law, Watercourses (Legal), Riparian land, Dam sites.

Running water belongs to the owner of the land over which it runs, but he may not interfere with its enjoyment by the next owner. Beds of non-navigable streams belong to the owner of the adjacent land; but if they are dividing lines, each owner owns to the thread of the stream. Provision is made for stream changes. Gradual accretions to land accrue to the owner. A definition of a navigable stream is given. Riparian owners' rights extend to the lowwater mark. An owner of a non-navigable stream may do with it as he pleases, except for creating nuisance. Dams for water power may be constructed by owners on land on the opposite side of a non-navigable stream, provided they pay damages for injury to private property. Title to the beds of non-navigable tidewaters is in the adjacent landowner. Provisions are made for waters forming boundaries. A definition of navigable tidewater is given. Title of owners adjacent to navigable tidewaters extends to the low-water mark. Owners of land adjacent to watercourses are empowered to ditch and embank their lands to avoid damage from overflows. Provisions are made for the establishment of bridges and ferries. No franchise granted by the state is to be exclusive unless expressly so stated. (Williams-Fla) W69-02010

LIABILITY FOR INJURY TO PROPERTY OC-CASIONED BY OIL, WATER, OR THE LIKE FLOWING FROM WELL,

For primary bibliographic entry see Field 05C. For abstract, see . W69-02011

POWERS AND DUTIES OF CITIES AND TOWNS--POWERS AND PROCEDURE FOR A TOWN TO ESTABLISH A WATER SUPPLY SYSTEM.

Mass Ann Laws, ch 40, secs 38-42 1 (1966).

Descriptors: *Massachusetts, Legislation, *Water supply, Water sources, Water control, Local governments, *Water works, Utilities, Water distribution (Applied), Water shortage, Human population, *Water management (Applied), Eminent domain, Fluoridation, Assessments, Taxes, Payment, Prices, Water rates, Administrative agencies.

Section 38 empowers a city or town, after approval of two-thirds of its governing council and a majority of its voters, to purchase water or water rights for the purpose of supplying water to itself and its inhabitants. A specific procedure is outlined in Section 39 and its subsections. A town can purchase and transport water from another town or it can establish its own water works, by taking land by eminent domain, constructing dams, reservoirs, etc., and electing a board of water commissioners to manage, improve, and control the waterworks. Subsection 39F enables inhabitants to recover damages incurred by the establishment of the water works, and subsection 39G provided penalties for any willful interference with the water system. Sections 40 and 41 enumerate various powers of the towns in connection with water supply, including the right to draw water from any stream, pond, reservoir or other ground source in case of emergency, taking property within the watersheds of water supply sources to protect and preserve the purity of the water, and restricting the inhabitants water use in case of emergency. Subsections 41 B and C give the voters control over fluoridation of the water supply. Subsections 42 A-F set out various procedures for collecting unpaid water charges. Subsections 42 G-I give the towns the power to assess property owners at a fixed uniform rate for the cost of laying pipes for water distribution. (Sisserson-Fla) W69-02012

DEPARTMENT OF WATER AND AIR RESOURCES OF NORTH CAROLINA. 21 N C Gen Stat sec 143-211 to 215 (1967).

Descriptors: *North Carolina, Legislation, Beneficial use, Water utilization efficiency, Public health, Water pollution, *Pollution abatement, *Water pollution control, *Administrative agencies, Coor-

dination, State governments, Federal government, Water allocation (Policy), Jurisdiction, Water management (Applied), Interstate, Water conservation.

An agency to administer a program of water pollution control and water resource management is created. The Board's organization is set out with specificity including apportionment of membership, compensation, and appointment of a director. It is declared that the legislature's intent is that the board cooperate with other states and with the federal government. The Board is directed to survey all of the state's waters, and to develop and adopt classifications and standards for all of the state's waters. Permissive criteria for assignment of classifications are set out. Permits are required from the Board in order for individuals to engage in activities which may provide new sources of water pollution. The Board is empowered to engage in activities for the abatement of present pollution sources as well. Judicial review of the Board's decisions is provided, and penalties for violations of orders are set out. The Board is further empowered to designate areas where water use requires regulation. (Pfeiffer-Fla) W69-02013

FRAUDULENT DIVERSION OR USE OF WATER.

Ala Code, tit 48, sec 411 (1958).

Descriptors: *Alabama, *Legislation, Reservoirs, Aqueducts, Pipes, Cities, *Diversion, Consumptive use, *Municipal water, Measurement, Instrumentation, Water measurement.

It is a misdemeanor punishable by a maximum fine of \$50 or imprisonment of 30 days to divert the water from any pipe, aqueduct, reservoir, main, or pipe of another person, water company, or any municipality authorized to supply water for public use. The diversion must be done with intent to defraud. Any person diverting water around a water meter or altering a meter so that it doesn't register is likewise guilty of the same misdemeanor. (Watson-Fla) W69-02014

CESSION OF SITES COVERED BY NAVIGABLE WATERS.

Ala Code, Tit 59, sec 3 (1958).

Descriptors: *Alabama, *Legislation, *United States, Federal government, Navigable waters, Ownership of beds, *Lighthouses, Jurisdiction, Federal jurisdiction, State jurisdiction. Identifiers: Beacons.

Authority is given to the governor of Alabama to convey title to state lands covered by navigable waters to the United States for the site of a lighthouse, beacon, or other aid to navigation. Proper application must be made by an authorized agent of the United States describing the site required for one of the purposes mentioned above. No single tract may contain more than 10 acres. The governor may also cede to United States such jurisdiction over the tract as is required. (Watson-Fla) W69-02015

IOWA'S NEW WATER STATUTE - THE CON-STITUTIONALITY OF REGULATING EXIST-ING USES OF WATER, Jeffrey O'Connell.

Iowa L Rev, Vol 47, No 3, pp 549-636, Spring 1962. 88 p, 528 ref.

Descriptors: Legislation, *Iowa, Competing uses, Riparian rights, *Water allocation (Policy), Administration, *Administrative agencies, *Water permits, Surface water, Groundwater, Water policy, Relative rights, Legal aspects. Identifiers: Quantity control, Constitutional law.

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Iowa established a permit system of water allocation in 1957, which is administered by a Water Commissioner. The statute applies to both existing and unused water rights and to both surface and groundwater. Permits are for 10 years and require beneficial use. The legislative history of the act, along with lowa's water resources and demands are discussed. Household uses are exempted from the act, as are uses under 5,000 gallons per day, existing uses within municipalities and use of water of border rivers. Other provisions are discussed. The hydrologic cycle is explained. Iowa water law before passage of the statute is outlined. The law's ignorance of the hydrologic cycle and reliance on courts to enforce water rights is pointed out. Existing water rights are property and are protected by both the state and federal constitutions. The arguments for and against the conclusion that the statute unconstitutionally impairs riparian rights are given. Cases on water statutes are discussed. The distinction between existing and unused rights is explained, and it is suggested that the term 'vested rights' in the statute be interpreted to mean 'used rights'. This would help its chances of being held constitutional. Limitations on riparian rights are discussed. The actual changes brought about by the lowa statute are carefully detailed. It is concluded that the act should not be held unconstitu-tional for regulating existing uses. (Williams-Fla) W69-02016

JOINT WATER SUPPLY FACILITIES.

N C Gen Stat sec 160-191.6--160-191.10 (1964).

Descriptors: *North Carolina, *Legislation, Streams, *Cities, Dams, Reservoirs, *Water supply, Reservoir storage, Financing, Intakes, Conduits, Pipes.
Identifiers: Bonds.

Any two or more municipalities in the State of North Carolina are authorized to acquire lands and water rights along any stream, to the extent they deem necessary or convenient, for the construction of a dam and reservoir to provide water to the municipalities. The municipalities are also empowered to maintain and improve the dam and reservoir facilities. The dam and reservoir facilities do not have to be within the corporate limits of the municipalities, and the municipalities are authorized to construct all intakes, mains, and all other facilities necessary to transport the water to them. The municipalities may enter into any agreements or contracts among themselves or with other parties pertaining to dividing water from the facilities, or to construct or maintain the dam and other facilities. The municipalities are also authorized to issue all bonds necessary to finance the acquisition, construction, or improvement of these water supply facilities. (Watson-Fla) W69-02017

BURCH V MACKIE (SURFACE RUNOFF). For primary bibliographic entry see Field 04A. For abstract, see. W69-02018

OBRECHT V NATIONAL GYPSUM CO (RIPARIAN RIGHTS IN GREAT LAKES).

361 Mich 399, 105 NW 2d 143 (1960).

Descriptors: Judicial decisions, *Michigan, *Great Lakes, Lake Huron, *Riparian rights, Beds, *Ownership of beds, Wharfs, Administrative agencies, State jurisdiction, Abatement.

Plaintiff homeowners on Lake Huron brought suit against the defendant riparian owner, which was building a large loading dock, and against the Michigan Department of Conservation to obtain a decree that an act authorizing such Department to convey to the defendant certain lake bottom lands was unconstitutional. Generally, the beds of the Great Lakes are inalienable and the public title and

right of Michigan in Lake Huron's bed is supreme against a riparian owner's right to wharf out. The legislature or its authorized agency must approve before any deep-water dock can be constructed. Since the area where this dock was constructed was substantially devoted to vacationing or living in the wooded sector of the shore, the defendant's act of constructing a dock in the locality constituted an actionable nuisance. Because the dock construction is completed, it would be an even greater wrong to force its removal, but plaintiffs can recover damages. (Williams-Fla) W69-02019

CERNAK V KAY-VEE REALTY (LIABILITY FOR SURFACE DRAINAGE DISCHARGE). For primary bibliographic entry see Field 04A. For abstract, see . W69-02020

SULLIVAN V BOARD OF COMMISSIONERS OF LORAIN COUNTY (INCREASED SURFACE DRAINAGE FROM UPPER LAND). For primary bibliographic entry see Field 04A. For abstract, see .

VILLAGE OF CHESTER V KANTOD PARK ASSOC, INC (WITHDRAWAL OF WATER FROM

W69-02021

LAKE). 13 A D 2d 709, 214 N Y S 2d 194-196 (App Div 1961).

Descriptors: *New York, Judicial decisions, Competing uses, Legal aspects, Water rights, *Withdrawal, Lakes, Cities. Identifiers: *Pleadings.

Plaintiff village sought an injunction to stop defendant corporation from withdrawing water from a lake to which the village claimed exclusive water rights. Defendant alleged as affirmative defenses that plaintiff came into court with unclean hands and that plaintiff suffered no damage by reason of defendant's withdrawal of water. The court held that since the defendant did not present any facts to support his pleadings, the defenses were insufficient. (Sisserson-Fla) W69-02022

LOUISVILLE AND NASHVILLE R R V BUSH (DRAINAGE OF SURFACE WATER). For primary bibliographic entry see Field 04A. For abstract, see . W69-02023

WYATT V WYCOUGH (ACCRETION).

341 SW 2d 18-22 (Ark 1960).

Descriptors: *Avulsion, *Arkansas, *Boundaries (Property), *Accretion (Legal aspects), Judicial decisions, Remedies, Adjudication procedure. Identifiers: Adverse possession, Ejection.

In an action for ejectment defendant claimed, among other things, that he had gained title by accretion. The court defined accretion as the increase of real estate by the addition of portions of soil by gradual deposition through the operation of natural causes. Avulsion is a sudden gain or loss of riparian land caused by the sudden abandonment by a stream of its old channel and the creation of a new one, or the sudden washing from one of its banks a considerable body of land and the depositing of it on the opposite bank. When a stream shifts suddenly by avulsion the boundaries of the riparian owners do not change with the course of the stream. In the present case evidence showed that an avulsion occurred and title to the land did not pass. (Kahle-Fla) W69-02024

AN ACT... TO SPECIFY THE POWERS OF THE DEPARTMENT OF WATER RESOURCES IN ESTIMATING WATER STORAGE NEEDS... AND TO AUTHORIZE CONTRACTS WITH FEDERAL AUTHORITIES FOR REPAYMENT OF WATER SUPPLY COSTS.

Maryland Laws Ch 671 (1967).

Descriptors: *Maryland, Legislation, Administrative agencies, State governments, Water supply, Reservoir storage, Streamflow, *Water quality control, *Cost repayment, Contract administration.

Section 53A added to Art 96A of the Annotated Code of Maryland (1964 Replacement Volume), entitled 'Water Resources', subtitled 'Other Powers and Functions,' specified certain powers of the Department of Water Resources. The Act empowers the departmenthen the need arises in the state for water supply storage or storage for stream-flow regulations for quality control, to estimate water storage needs in federally constructed reservoirs in the state and to contract with federal authorities for repayment of water supply costs. (Sisserson-Fla) W69-02025

CITY OF BANGOR V PUBLIC UTILITIES COMM'N (WATER ALLOCATION). 167 A 2d 6-17 (Me 1960).

Descriptors: Water allocation, Watercourses, Water control, Water rates, Water districts, *Water delivery, Water measurement, *Water supply, Water utilization, Public utilities, Administrative agencies, Administrative decisions, Cities, Judicial decisions, *Financing, *Maine.

Prior to the formation of the Bangor Water District, water taken from the Penobscot River was sufficient for fire fighting purposes of the city of Bangor. But with the advent of the new system, designed to carry water for fire protection as well as for general consumptive use, use of river water was abandoned. The issue raised by the city of Bangor, through exceptions to an order of the Public Utilities Commission, was the proper allocation of the cost of the new system between fire protection and general use. After an extensive analysis of methods of apportionment and the opposing viewpoints of the city and the Public Utilities Commission, the Supreme Court of Maine held that the cost of the new system was properly allocated between fire protection and general users on a capacity basis rather than on the basis of estimated water use. (Carruthers-Fla) W69-02026

MARINE BOUNDARIES OF THE COMMON-WEALTH.

Mass Ann Laws, Ch 1, Sec 3, 1966.

Descriptors: *Massachusetts, Boundaries (Property), Low water mark, State jurisdiction, Water rights

The territorial limits of the commonwealth shall extend one marine league from its seashore at extreme low water mark, and the exterior line of the commonwealth as located and defined by the Board of Harbor and Land Commissioners under chapter one hundred and ninety-six of the acts of eighteen hundred and eighty-one shall be prima facie the marine boundary of the commonwealth. If an inlet or arm of the sea does not exceed two marine leagues in width between its headlands, a straight line from one headland to the other shall be equivalent to the shore line. (Horner-Fla) W69-02028

MASSACHUSETTS COUNTY BOUNDARIES IN TERRITORIAL WATERS. Mass Ann Laws, Ch 34, Sec 1 (1966).

Descriptors: *Massachusetts, *Boundaries (Property), *Local government, *Tidal waters, Legisla-

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tion, Cities, Jurisdiction, State governments, State jurisdiction.

This section establishes the marine boundary of the commonwealth as the boundary of counties bordering on the open sea. It establishes the boundary lines in tide water between coastal municipalities as the boundary lines between the respective counties in which they are located. Counties separated by waters within the jurisdiction of the state shall exercise concurrent jurisdiction over such waters. A case note to the section illustrates that the statute is one of those which expressly provides for the inclusion of territorial waters within county limits. (Smodish-Fla) W69-02029

LANDS RESERVED TO THE STATE. Ga Code Ann Secs 91-102 (1967).

Descriptors: *Georgia, Legislation, *State governments, *State jurisdiction, Islands (Public lands). Identifiers: State lands.

Secs 91-102 provides that the lands specially reserved to the state are: the lands known as the 'McIntosh Reserve,' on which Indian Spring is situated; a quantity of land on Flint River, opposite the Old Indian Agency; one mile square on the Chattahoochee River at McIntosh Ferry; five miles square on the Chattahoochee River at Cusseta Falls, including the falls; all islands contained in any of the navigable waters of the state and not disposed of, and the western bank of the Chattahoochee River to the highwater mark, where it forms the boundary between Georgia and Alabama; the fractional parts of surveys created by the different land divisions which are not granted otherwise disposed of; and all lands omitted to be surveyed, granted or sold. (Williams-Fla) W69-02035

PROBLEMS AND PROGRAMS IN WATER POL-LUTION.

For primary bibliographic entry see Field 05G. For abstract, see . W69-02036

REGULATION OF CANALS.

For primary bibliographic entry see Field 04A. For abstract, see . W69-02042

OHIO WATER MANAGEMENT AND WATER POLLUTION CONTROL.

Ohio Laws Ch H 314 (1967).

Descriptors: *Ohio, *Administration, *Water pollution control, *Administrative agencies, Legislation, Water resources development, Planning, Coordination, State governments, Regulation, Sewage disposal, Waste disposal, Treatment facilities, Standards, Water quality, Grants, Permits, Administrative decisions, Judicial decisions, Water pollution.

Identifiers: Water Pollution Control Act, State

The Act amends and enacts several sections of the Revised Code. It provides for the appointment and composition of the department of natural resources and enumerates the powers of the director of natural resources. The Act creates and establishes the composition of the Ohio water commission within the department of natural resources. It declares the purposes and powers of the commission. The Act also establishes supervision over the treatment and disposal of industrial wastes by the department of health. The water pollution control board is established by the Act, which also provides for its composition and specified its powers. Any pollution of the waters of the state is declared a public nuisance, except where the water pollution control board has issued a permit. A permit issued by the

water pollution control board is required before disposing of any sewage or wastes in the waters of the state, except in specified situations. The water pollution control board is empowered to adopt water quality standards. The Act includes definitional sections and sections pertaining to adoption of rules and regulations, appeals from findings of the director of health, funding of projects, and coordination among agencies. (Smodish-Fla) W69-02043

GEORGIA WATERWAYS COMMISSION.

Ga Code Ann Secs 17-301 -- 17-306 (1967).

Descriptors: *Georgia, Legislation, *Administrative agencies, *River basin development, Federal government, *Flood control, Rivers. Identifiers: Water agencies.

The Georgia Waterways Commission is created, consisting of a chairman and one member from each of the five major river basins. Terms of office, vacancies and compensation are set forth. The Commission is directed to negotiate with the federal government regarding river development, particularly flood control. It has no power to make binding contracts or obligations. (Williams-Fla) W69-02058

WATER SUPPLY QUALITY CONTROL.

Ga Code Ann Secs 88-2601 -- 88-2618 (1967).

Descriptors: *Georgia, Legislation, *Administrative agencies, Administration, *Water quality control, *Water supply, Standards, Water permits, Water utilization, Water resources, Water sources. Identifiers: Water agencies.

Legislative policy is that the prudent use of water and its quality are major factors involving the health and welfare of the people of the state. The Board of Health is designated as the agency to administer the provisions of this act. The Board is to: establish water quality standards; establish standards relating to storage, distribution and treatment of water; conduct studies and research; issue certificates for the operation of community water systems; cooperate and enter agreements with other agencies; promulgate rules and regulations; and issue orders. Operation of any community water supply is unlawful without Board approval. The Board is granted access to any property for the purpose of making investigations. Information secured by the Board may not be used in a suit involving private rights, and certification is not a good defense to such suit. Appellate procedures, penalities, and emergency powers are adopted. The Director is authorized to bring actions for injunctions to abate public health hazards. (Williams-Fla) W69-02060

MUNICIPAL WATER RIGHTS,

Edward F. Taylor.

Journal of the American Water Works Assoc, Vol 58, No. 7, July 1966, pp 856-865, 49 ref.

Descriptors: Water supply, *Water law, Legal aspects, Federal government, Legislation, Water rates, *Municipal water supply, State governments, Local governments, Federal jurisdiction, State jurisdiction, Regulation, *Water rights, Water contracts.

Identifiers: Municipal water rights, Discriminatory rates, Franchise fees.

The lack of a clear definition of national and local rights in water has contributed to the deterioration of federal-local regulations. The federal position is that the government owns rights to water under state law, without being subject to the same restrictions imposed by state legislatures upon nonfederal claimants. A bill before Congress (S. 1275) sets forth reasonable conditions for the acquisition and exercise of water rights by federal agencies,

and does not abridge any constitutional power. The bill's principal provisions are reviewed and discussed. Such legislation will preserve the historic role of municipal corporations and the states in water resource development and will protect local water rights. A number of decisions, which support the general rule that a municipality may exercise reasonable and fair discretion in determining whether to make extensions of its lines are cited. As a general rule, water rates set by municipal officers charged with legal duty, will not be overruled without clear proof of unreasonable charges set in an arbitrary and illegal manner. The cases in which this principle is reaffirmed are noted and serve to further define municipal water rights. Other legal considerations in discriminatory rates, regulations, enforcement, collection and franchise fees are discussed and serve as an indication of the legal boundaries imposed on municipal water rights in relation to other governmental jurisdictions. (Gargola-Chicago) W69-02300

FINANCIAL MANAGEMENT OF A WATER UTILITY.

City Water Board, San Antonio, Texas. For primary bibliographic entry see Field 06B. For abstract, see . W69-02301

MANAGEMENT RESPONSIBILITIES AND OBJECTIVES IN INVESTOR-OWNED AND MUNICIPAL UTILITIES,

Northern Illinois Water Corp., Champaign, Illinois. Edward R. Healy.

Journal of the American Water Works Ass, Vol. 58, No. 5, May 1966, pp 511-516.

Descriptors: *Water management, Administrative decisions, Investment, *Public utilities, Water rates, Local governments, *Political aspects, Pricing, Financing, Water quality, Project planning. Identifiers: Water services, Return on investment.

Examined are the investor-owned and the municipally-owned utility for the purpose of evaluating management responsibility and objectives. The investor-owned utility is a business concern with the prime purpose of earning a profit. For this reason, it must sell its product, water, at a price to cover costs. In doing this, responsibility to the three major concerned groups, customers, stockholders, and employees, is met. The municipally-owned utility should have the same responsibilities, therefore, the same objectives, as an investor-owned utility. In certain cases this is recognized by the municipal administration, but difficulties stand in his path. The water utility operated as a department of the municipal government is too often used to further some political or social objective. Also, the real managerial decisions are often made by an elected or appointed commissioner, whose primary qualifications are political. Management responsibilities should be the same regardless of the type of ownership. The only practical way to accomplish this is by the complete removal of politics from the management of the utility. (Gargola-Chicago) W69-02305

NEW MANAGEMENT TECHNIQUES,

Kaiser Aluminum and Chemical Corp., Oakland, California.

James R. Schultz.

Journal of the American Water Works Assoc., Vol. 59, No. 6, pp 675-679.

Descriptors: Motivation, Behavior, Attitudes, *Administrative decisions, Social participation, Social aspects, *Social adjustment, Human resources, *Employment opportunities.

Identifiers: T-group method, Pattern of inquiry, Psychological testing.

There is mounting evidence of critical deficiencies in systems of management; personality appraisals, boss subordinate counseling sessions, statistical

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measures of performance, communication devices, efficiency programs and other tools of management need reevaluation. A scientific approach to management is necessary, involving the asking and answering of the proper questions: How many jobs will be eliminated due to technology; How many jobs will be vacated or created because of turnover and growth; How will the net manpower requirements break down in terms of production, engineering, and marketing; and Where is the back strength weakest and strongest in terms of meeting long range needs. Motivation and assumptions about people are discussed, and the shifting basis of authority considered. The potential skilled man-power shortage is realized and suggestions made for seeking out alternative talent; search out talent beyond the immediate range of succession and let workers realize their potential within the organization. In implementing career plans, certain flexible guidelines should be observed: (1) a man should not be moved to a new position until he has mastered the old, (2) a new position should offer a full challenge, (3) developmental moves should be aimed to coincide with normal replacement requirements and (4) outside schooling should complement the experience and training offered on the job. Mutual establishment of goals and deadlines for current responsibilities by both management and salary has been shown to have the most significant effect on productivity. Management by fragmented programs and techniques is becoming obsolete, and objective planning constructed around a pattern of inquiry must replace it. (Gargola-Chicago) W69-02310

ANALYSIS OF FEDERAL WATER POLLUTION CONTROL LEGISLATION, 1948-1966, Cornell Univ., Ithaca, New York. Water Resources

Center.

For primary bibliographic entry see Field 05G. For abstract, see . W69-02312

WATER-QUALITY CONTROLS ENFORCEA-BLE IN COURTS UNDER STATE LAW, For primary bibliographic entry see Field 05G. For abstract, see

POLLUTION AFFECTING RIPARIAN RIGHTS IN DEFINED CHANNELS OR DEPRESSIONS ON THE SURFACE OF THE GROUND, Burton J. Gindler.

In R. E. Clark's Waters and Water Rights, Vol 3 Water Pollution and Quality Controls, 1967, pp 53-

Descriptors: *Riparian rights, Water pollution, *Reasonable use, Water quality, Watercourses (Legal), Lakes, *Invasion, Wastes, Sewage disposal, Streams, Dams, Backwater, Appropriation, Channels, Natural flow doctrine, *Social values, Damages, Water law.

A riparian right to the use of water from a watercourse or lake extends to the quality of that water as well as to its quantity. The rationale of liability for pollution rests on the natural-flow theory, which seeks to preserve the natural flow, and the full beneficial or reasonable use theory, which places emphasis on the greatest utilization of the water. For the defendant to be liable for an unintentional invasion there must be substantial harm and negligent, reckless, or ultrahazardous conduct. The defendant can be found liable for an intentional invasion if the plaintiff suffers substantial harm and the utility of the defendants conduct does not outweigh the gravity of the harm to the plain-tiff. Comparisons must be made between the conflicting social values, but there is usually a preference for natural uses. Important factors in determining the reasonableness of pollution by defendant's riparian use are the practicability of defendant's preventing or avoiding the harm being caused by his use, and the burden on the plaintiff of

avoiding the harm. There is a definite preference for riparian users and uses as opposed to nonriparian. (Watson-Fla) W69-02315

POLLUTION AFFECTING APPROPRIATIVE RIGHTS IN DEFINED CHANNELS OR DEPRES-SIONS ON THE SURFACE OF THE GROUND, Burton J. Gindler.

In R. E. Clark's Waters and Water Rights, Vol 3 Water Pollution and Quality Controls, 1967, pp 89-

Descriptors: *Appropriation, *Riparian rights, *Water pollution, Water quality, Watercourses (Legal), Lakes, *Invasion, Channels, Damages,

The superior right of the prior appropriator is preferred over the junior right of a subsequent appropriator, whose right in turn is preferred over an appropriation subsequent to his. That preference has two results: (1) the subsequent appropriator is subject to liability for damages for polluting the water used by a prior appropriator; (2) the prior appropriator is not subject to liability for polluting the water used by a subsequent appropriator. The preference is limited in four ways: (1) the pollution must affect one of the purposes for which the prior appropriation was made; (2) the pollution must affect actual or contemplated uses within the scope of the prior appropriation; (3) the pollution must cause substantial harm to such uses; (4) under all the facts and circumstances of the case, the pollution or the harm must not be practicably avoidable or preventable by the prior appropriator -- assuming first that they are not practicably avoidable or preventable by the subsequent appropriator or other junior water user. If the invasion is unintentional the subsequent appropriator is liable only if there is substantial harm and his conduct is negligent, wreckless or ultrahazardous. (Watson-W69-02316

POLLUTION OF WATER IN DEFINED CHAN-NELS OR DEPRESSIONS ON THE SURFACE THE GROUND UNDER COMBINED RIPARIAN-APPROPRIATIVE SYSTEMS, Burton J. Gindler.

In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp

Descriptors: *Riparian rights, Appropriation, *Prior appropriation, Water rights, Beneficial use, *Preferences (Water rights), Priorities, Channels, Invasion, *Competing uses, Reasonable use, Water pollution.

Identifiers: Negligence.

The relationship between riparian and appropriative rights has given rise to two types of problems. First, in jurisdictions that recognize both riparian and appropriative rights pollution from the use of water under one type of right may interfere with the use of water under the other type of right. In general, one right will be prior to the other, and in most instances the riparian rights are preferred over the appropriative. Second, some jurisdictions apply or attempt to apply the law of riparian rights to cases involving appropriative rights. In strict logic, under the appropriation system the rule governing equal but correlative riparian rights could be applied only where the appropriations are of equal priority. (Watson-Fla) W69-02317

POLLUTION OF WATERS UNDER THE SUR-FACE OF THE GROUND, Burton J. Gindler.

In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp Descriptors: Riparian rights, Appropriation, Invasion, Prior appropriation, Water rights, Priorities, Channels, Prior appropriation (Water rights), Competing uses, Reasonable use, *Water pollution, Subsurface waters, *Percolating water, *Underground streams, *Underflow.

Underground waters are classified: (1) underflow of surface streams; (2) subterranean flowing streams; and (3) subterranean percolating waters. The underflow of a surface stream is considered to be a part of the watercourse itself. Rights in the watercourse include rights to the underflow. The rules governing rights to water quality of watercourses and lakes are equally applicable to their underflows. A subterranean flowing stream is a definite stream of water that is flowing through a definite underground channel. At law it is treated like a watercourse, and the rules governing water quality are equally applicable. Subterranean per-colating waters are all waters slowly filtering or seeping through the ground that are not a part of a watercourse or an underground flowing stream. Subterranean waters are presumed to be percolating waters until proven to be flowing waters. At common law the owner of the land was the absolute owner of all percolating waters thereon, and was responsible to no one for pollution. This theory is still used in some jurisdictions with exceptions. Other jurisdictions apply correlative or riparian rights, appropriative rights, or combined correlative and appropriative rights systems to percolating waters, and apply the rules governing watercourses and lakes in their system to percolating waters. (Watson-Fla) W69-02318

POLLUTION OF WATER ON THE SURFACE OF THE GROUND BUT NOT IN DEFINED CHANNELS OR DEPRESSIONS,

Burton J. Gindler. In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp 122-124.

Descriptors: *Surface runoff, *Channels, Subsurface waters, *Riparian rights, Appropriation, Invasion, Prior appropriation, Water rights, Priorities, Competing uses, *Reasonable use, Water pollu-

Identifiers: Liability.

Pollution that interferes with the use of diffused surface water does not often occur. Generally rights to the use of diffused surface waters cannot be acquired, either in the riparian or the appropriative water-rights systems. Consequently, defendant's pollution of such waters, by use or otherwise, cannot interfere with any right of the plaintiff to the use of such waters. If and when rights do attach, defendant's liability for pollution that interferes with plaintiff's use of such waters will be governed by the same general rules that apply to appropriative rights to waters in watercourses and lakes or in subterranean waters. Under the rule of the Restatement of Torts, a possessor's use of surface waters on his land which pollutes the waters so as to interfere with another's use of them on other land is ordinarily reasonable; the possessor is not subject to liability unless the primary purpose of his use is to harm the other. This rule is said to be a crystallization of the principle of reasonable use generally applicable to the use of land. This rule is intended to apply only to the direct use of surface water. (Watson-Fla) W69-02319

SOME FORMS OF ABSOLUTE LIABILITY FOR WATER POLLUTION,

Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp

Descriptors: *Water pollution, Water rights, Reasonable use, *Invasion, *Riparian rights, Sewage, *Legislation.

Water Law and Institutions—Group 6E

Identifiers: Absolute liability, Negligence per se,

Certain forms of water pollution are said to be unreasonable per se, as a matter of law. Absolute liability may arise because of the nature of the water rights involved; for example, pollution by an intentional invasion from a nonriparian use is unreasonable per se when it causes substantial harm to the riparian use of a riparian owner. Liability per se may be based on the nature of the pollutant such as the discharge of untreated sewage. A penal statute may establish the standard of a reasonable man, violation of which is negligence per se. Negligence per se is applicable only in the case of an unintentional invasion. To prevail in a cause of action based upon liability per se, plaintiff must plead and prove three elements: (1) defendant has violated a statutory proscription against pollution; (2) plaintiff has suffered substantial harm; and (3) defendant's pollution in violation of the statute caused plaintiff's damages. Neither a public or private water purveyor are held to strict liability for the purity of water which they distribute for con-sumption and domestic use. Either, however, can be held liable if negligence is proven. (Watson-Fla)

JUDICIAL REMEDIES AGAINST POLLUTION,

Burton J. Gindler. In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp 136-171.

Descriptors: Water pollution, Water rights, Reasonable use, Invasion, Riparian rights, *Remedies, Water quality, *Abatement, *Damages, *Competing uses, Legislation, Eminent domain.

Identifiers: Declaratory relief, Injunction.

Remedies available to protect private rights to water quality include declaratory relief, quiet title decree, abatement by self-help, damages, and injunction. Declaratory relief or a quiet title decree should be available under the law of the applicable jurisdiction. Abatement by self-help is allowed where, under the law of the particular jurisdiction a person is privileged to go upon the land of another to abate a private nuisance. Almost all private litigation over water pollution is brought to recover damages or to obtain an injunction, or both. Remedies must always be considered in light of the different kinds of harm that defendant may inflict upon plaintiff by water pollution. The primary consideration in determining money damages for water pollution is whether the plaintiff has suffered temporary or permanent damage. Injunctive relief is available to plaintiff to prevent continuance or to ameliorate some effects of defendant's pollution that causes or threatens to cause substantial harm to plaintiff's interest in the use of water. The determination of defendant's liability for a nuisance involves a balancing of conflicting interests. Even if the defendant loses this balancing of interests and has to pay damages his pollution may not be flagrant enough to warrant an injunction. (Watson-W69-02322

DEFENSES IN WATER-POLLUTION LITIGA-

Burton J. Gindler. In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp 171-190

Descriptors: *Water pollution, Water rights, Reasonable use, Invasion, Riparian rights, Remedies, *Damages, Competing uses, Legislation, *Easements, *Prescriptive rights, Legal

Identifiers: Injunctions, Defenses, Negligence, Assumption of the risk.

The holder of a water right may grant an affirmative easement by which another person may cause

what would otherwise be a wrongful pollution of the holder's water supply. The defendant in a water pollution case may also defend on the ground that he has acquired an easement of pollution by prescription. This is accomplished most often by the running of the statute of limitations and merger of prior judgments. The defendant can also use contributions to the pollution made by others as a defense. This defense does not prevent recovery, but it does allow the defendant to bring in other liable parties to share the damages. Although there is some old authority that plaintiff is barred from any remedy resulting from a pollution to which he contributed, the contributory-pollution defense alone will usually not bar recovery. It will, however, limit defendant's liability for the damages. Contributory negligence of plaintiff is a possible defense only if defendant's activity is merely negligent, causing an unintentional invasion rather than an intentional one. Generally assumption of the risk, the plaintiff acquiring the property with knowledge that the pollution was occurring, is no defense. (Watson-Fla) W69-02323

LEGAL ASPECTS OF PENNSYLVANIA WATER RESOURCES PLANNING, Pennsylvania State Univ., University Park. Institute

for Research on Land and Water Resources For primary bibliographic entry see Field 07B. For abstract, see W69-02324

RELATIVE ROLES OF LAW AND ECONOMICS IN THE FORMULATION OF WATER POLICY. Wyoming Univ

For primary bibliographic entry see Field 07B. For abstract, see . W69-02325

DEVELOPING TRENDS IN WATER LAW IN THE EASTERN STATES.

Department of Agriculture, Economic Research

Harold H. Ellis.

Proceedings of the Water Resources Law Colloquium, Institute for Research on Land and Water Resources, Information Report No 51, pp 24-45, July 1967. 22 p, 38 ref.

Descriptors: *Legislation, Administrative agencies, Judicial decisions, Legal aspects, *Water law, *Water permits, *Riparian rights, Percolating *Water permits, *Riparian rights, Percolaung water, Streams, Low-flow augmentation, Inter-state compacts.

The courts in the eastern states rely heavily on the riparian doctrine. Riparian land, natural flow, unity of title, use of water on non-riparian land, public rights, reasonable use and several concepts connected with riparian rights are discussed. Diffused surface water may, according to the few cases on the point, be used almost entirely as the owner of the land upon which they occur sees fit. Most cases involving such waters deal with drainage. Underground streams are governed by the riparian doctrine. The rules applying to percolating ground-water are discussed. State legislation ranges from mere codification of court-made rules to far reaching adjustments. Water-use permit systems are discussed, with special reference to Iowa, Minnesota and Mississippi. Statutes allowing use of water on non-riparian land are outlined. Provisions are made by some statutes for water storage during high-flow periods for use during periods of low flow. Pollution control statutes are mentioned. Some states have utilized special districts or some states have utilized special districts or authorities to implement water policy. Floodplain zoning is mentioned. New developments are discussed and new approaches to water problems such as inter-disciplinary research and interstate cooperation are suggested. (Williams-Fla) W69-02326

TRANSITION FROM RIPARIAN DOCTRINE, Mississippi Univ., School of Law. William M. Campion.

Proceedings of the Water Resources Law Colloquium, Institute for Research on Land and Water Resources, Information Report No 51, pp 46-57, July 1967. 12 p.

Descriptors: *Mississippi, Administrative agencies, *Riparian rights, *Prior appropriation, Water permits, Legislation, *Competing uses, Relative rights, Water law, Legal aspects, Administration, Political aspects, Droughts. Identifiers: Vested rights.

Drought conditions, a desire to lure industry and concern of conservationists prompted the 1956 Mississippi legislature to adopt a prior appropriation-type water allocation law. Study by the Missis-Water Resources Policy Commission is discussed. The Commission studied climate, pollution, surface waters, irrigation, watersheds, and groundwater. The Commission also studied water uses and needs of agriculture, industry, and municipalities. In its report to the 1956 legislature the Commission recommended the adoption of a prior appropriation system. The statute protects vested riparian rights, and provides basically for a permit system. Average minimum flows are to be established and no permits granted which would invade them. Permits define the extent of the appropriation right. Non-use or unauthorized use for a period of three years results in a forfeiture of the right. Permit rights are transferrable with the land. Exclusions from the law are discussed, and it is pointed out that the statute does not recognize surface and groundwater inter-relationships or provide adequate police powers. The Act's primary purpose is to resolve conflicts among competing users. 92 percent of the requests for permits were made by owners of vested riparian rights. Suggestions for adopting prior appropriation in Pennsylvania are made. (Williams-Fla) W69-02327

EMINENT DOMAIN--RIPARIAN RIGHTS ... DEPRIVATION OF ACCESS TO NAVIGABLE WATERWAY IS NOT COMPENSABLE--COLBERG V STATE,

Ruth R. Budd.

Boston College Ind and Com L Rev, Vol 9, No 3, pp 770-780, Spring 1968. 11 p, 53 ref.

Descriptors: *California, Judicial decisions, Riparian rights, Riparian land, *Navigable waters, Navigation, *Compensation, Eminent domain, *Access routes, Highways. Identifiers: Property rights.

This is a case comment on Colberg v State (432 P 2d 3 (1967)). The State of California proposed to construct twin stationary freeway bridges across a channel, cutting off plaintiffs' riparian land, where they operated shipyards, from access to navigable waters and the sea. The height of the bridges would cut off 81 percent of one company's business, and 35 percent of the other's. On appeal, the California Supreme Court held that plaintiffs' rights of access to navigable waters were burdened with a servitude in favor of the state. Diminution of that right by a valid exercise of the state's power to deal with its navigable waters was not compensable. This case is contrasted with analogous cases involving impairments to street access by freeways. The case is criticized in that it actually does deprive the riparian owners of a private property right, free navigation, without compensation. The rule used in this case is even broader than the federal servitude theory. The background of the California rule is discussed, and the case is generally criticized for its apparently narrow approach to compensable property rights. (Williams-Fla) W69-02328

AUSTRALIAN AND AMERICAN WATER AL-LOCATION SYSTEMS COMPARED,

Peter N. Davis.

Boston College Ind and Com L Rev, Vol 9, No 3, pp 647-710, Spring 1968. 64 p, 343 ref.

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Descriptors: Legislation, Prior appropriation, Riparian rights, *Water permits, *Water policy, Water law, Administrative agencies, *Water allocation (Policy), *Administration, Competing uses, Distribution, Water rights, Preferences (Water rights).

The riparian doctrine is questioned as being adequate to meet the task of water allocation in the eastern United States. Australia employs a temporal non-priority permit system of water alloca-tion. A government agency issues water use rights, permits and licenses and may revoke them without regard to the time of issuance, much like the system in Minnesota. The history of the development of Australian irrigation areas, legal problems posed by the change from the common-law riparian doctrine to licensing, and the licensing statutes are discussed. Any good system of water allocation should: (1) provide secure rights; (2) maximize efficiencies; (3) be flexible enough to allow new uses; (4) protect the public interest; and (5) rely mainly upon private rights. The riparian system, prior appropriation system, temporal non-priority permit system, and marketplace concepts are said to be the four major water allocation concepts in the United States. Each is analyzed in detail with reference to its fulfillment of each of the five requirements of a good water allocation system. The concludion is drawn that riparianism and prior appropriation are becoming outmoded, and that the temporal non-priority permit system would be the most appropriate system for the eastern states.

(Williams-Fla)

W69-02329

WATER-SUPPLY STRINGENCIES--FEATURES, ANTECEDENTS AND OBSTACLES TO RESOLUTION,

U. S. Geological Survey. Arthur M. Piper. Boston College Ind and Com L Rev, Vol 9, No 3, pp 633-646, Spring, 1968. 14 p, 34 ref.

Descriptors: Natural streams, Streams, Ground-water, Hydrologic aspects, Reservoirs, Surface waters, Consumptive use, Irrigation effects, *Riparian rights, *Prior appropriation, *Beneficial use, *Competing uses, Water conservation, Reasonable use, Water yield improvement, Water control, Water management (Applied), Administration

As water supply facilities are outgrown many centers of large water demand will turn to interregional transfers of water. To reduce the problems inherent in such projects, optimum reuse of local supplies must be made. One method is to improve water quality of streams through pollution control. But even when regulated to the utmost, it is doubtful that our streams can deliver projected supply requirements. The principle of an absolute and timeless water right imbedded in the prior appropriation and riparian rights doctrines impairs resolution of quantity and quality problems. Risk of forfeiture accompanying failure to use the appropriated amount has led to wasteful irrigation practices in the West. In addition there are no effective methods for adjustment of water rights to accommodate changing purposes. Municipalities inefficiently sterilize all water delivered when only a small percentage of use requires sterilization. The controlling policy is devising new water manage-ment policies should be reappraisal of individual rights against total water supply commitment and rights against total water supply commitment and requirement. The police power might be exercised to periodically verify or adjust withdrawal in relation to continuing use. Preferably, water conservancy districts might be created with jurisdiction over an entire natural water supply to exercise all participating water rights jointly for optimum advantage. (Kahle-Fla) W69-02330

DEEP-WELL DISPOSAL OF WASTES, U. S. Geological Survey, Washington, D. C. For primary bibliographic entry see Field 05E. For abstract, see. W69-02342

6G. Ecologic Impact of Water Development

POWER OF MASSACHUSETTS METROPOLITAN PARK COMMISSION.

Mass Ann Laws, Ch 92, Sec 33, 38, 39 (1966).

Descriptors: *Massachusetts, *Administrative agencies, Parks, *River regulation, Legislation, Rivers, Ponds, Recreation, *Recreation facilities, Regulation, Water pollution control, River basins, Water rights, Cities, Planting management, Maintenance, Trees, Shrubs, River basin development, Water supply.

Section 33 empowers the commission to regulate the use of spaces along rivers or ponds to make them more available as spaces for recreation. The commission is authorized to maintain these spaces, and to plant, maintain, and remove trees and shrubs within them. The section does not limit the existing rights of any town in relation to water supply purposes. Section 38 authorizes the commission to make rules and regulations, not impairing freight traffic for the care, maintenance, protection and policing of the Charles River basin. Violations of such rules are declared breaches of the peace punishable by fine not exceeding \$50. The commission shall publish the rules once in a Boston newspaper. This shall constitute sufficient notice to all persons. The sworn certificate of any member of the commission shall be prima facie evidence of such publication. A copy of a rule attested by any member shall be prima facie evidence that the rule was made by the commission. Section 39 empowers the commission to make regulations prohibiting pollution of the Charles River within the metropolitan park district. Violation is punishable by fine not exceeding \$1000. (Smodish-Fla) W69-02032

RIGHT OF PUBLIC TO FISH IN STREAM NOT-WITHSTANDING OBJECTION BY RIPARIAN OWNERS,

J. H. Crabb. 47 ALR 2d 381-418.

Descriptors: Riparian land, *Riparian rights, *Fishing, Navigable rivers, Rivers, Streams, *Navigable waters, Riparian waters, Recreation, Running waters, Banks, *Nonnavigable waters, Public rights, Shellfish, Judicial decisions, Ownership of beds, Watercourses (Legal), Prescriptive rights.

Fish are generally considered to be the property of no one unless they are removed from the water or confined in private water, from which there is no reasonable possibility of their escape. Even though fish while uncaptured are not subject to private exclusive proprietorship in certain waters. Rules governing bodies of water such as lakes, bays, and arms of the sea are beyond the scope of the annotation. The exclusive right to fish in adjacent waters is not necessarily an inherent incident of riparian ownership and most issues discussed arise as an action of trespass by the riparian owner against a defendant who had been fishing in the stream flowing by the plaintiff's banks. Generally fishing in navigable streams is open to the public and is not subject to exclusive riparian ownership or control, while fishing rights in nonnavigable streams are privately owned by the adjacent riparian owners. (Smith-W69-02056

CONTROLLING INDUSTRIAL WATER POLLUTION: COLOR THE PROBLEM GREEN, lowa Univ. Law School.

Iowa Univ. Law School.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02331

07. RESOURCES DATA

7A. Network Design

COUNTY RAIN-GAGE NETWORK USEFUL IN DESIGN,

A. R. Pagan, and R. Rothenberg. Civ Eng, Vol 35, No 4, pp 68-9, April 1965.

Descriptors: *Rain gages, Design, *Drainage system.

Bergen County, NJ, supplements two recording rain gages with 13 nonrecording gages read and reported by unpaid volunteers; small plastic gages are used; information gained serves to supplement data from U S Weather Bureau for design of drainage structures; readings in one case proved unusual rainfall in small area and indicated no need for additional facilities.

SECONDARY MOTIONS APPLIED TO STORM SEWAGE OVERFLOWS,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02109

DESIGN, CONSTRUCTION AND PERFORMANCE OF VORTEX OVERFLOWS, For primary bibliographic entry see Field 04A. For abstract, see .

W69.02114

HYDRAULIC ASSUMPTIONS IN CALCULATING STORM-WATER OVERFLOWS, For primary bibliographic entry see Field 04A.

For primary bibliographic entry see Field 04A For abstract, see .
W69-02119

FOCUS ON RESEARCH. WATER POLLUTION RESEARCH AND THE MUNICIPAL ENGINEER.

For primary bibliographic entry see Field 05D. For abstract, see . W69-02126

HOW TO SIZE CONDUITS FOR STORM SEWERS.

For primary bibliographic entry see Field 08A. For abstract, see . W69-02184

SOME APPLICATIONS OF RESEARCH IN THE DESIGN OF SEWERAGE AND SEWAGE-TREATMENT WORKS,

For primary bibliographic entry see Field 05D. For abstract, see . W69-02233

7B. Data Acquisition

TV GOES UNDERGROUND AT FORT LAUDERDALE.

C. S. McKinney, R. W. Campbell, and F. C. Funnell.

Water Poll Control Fed J, Vol 38, No 2, pp 179-85, Feb 1966.

Descriptors: *Equipment, Sewers. Identifiers: *Leak detection.

Small TV camera was used for viewing inside of pipe lines and locating failures of PVC jointed terra-cotta pipe to obtain data necessary to repair constantly developing leaks; equipment included aluminum paneled van-type truck outfitted with

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portable generator for power, intercom system and radio for communications, cupboards and cabinets for storage, and air conditioning unit to keep truck and equipment cool for efficient operation; camera, 6 3/4 in. in diam, had as its light source six miniature floodlights mounted around lens. W69-02075

FLOW MEASUREMENT,

V. C. Parker.

Louisiana State Univ-Div Eng Res-Bul 89, pp 116-27, 1967.

Descriptors: *Flow measurement, *Flowmeters, Weirs.

Measurement of water and waste-water flow with rate-of-flow meters and quantity meters; design and application of rate-of-flow meters discussed includes variable-head, variable area-constant head, electromagnetic, and sonic velocity meters; rough field measurements; features of rectangular, notch, trapezoidal, parabolic notch, and broadcrested weirs are reviewed. W69-02080

THE SYSTEMATIC ERROR IN RAINFALL MEASUREMENT,

I C Rodda

J Inst Water Eng, Vol 21, No 2, pp 173-177, March 1967.

Descriptors: *Rain gages, *Standards, Rain.

Various methods for overcoming the effect of wind on the amount of rain collected by a rain gauge are discussed. It has been found that a rain guage at ground level gives the measurement approaching closest to the real rainfall, but this is still not the real solution to the problem. No absolute standard for rainfall measurement is yet available, as there is for stream flow, and it appears to the author that only a small amount of progress is possible without one. In the past a simple rule has been adopted—that the guage giving the largest catch is the best. The author feels that this cannot be sufficient justification for a guage in the future; neither can the use of a particular guage for 100 years be used as an adequate reason for continuing to use it. W69-02081

RADAR ESTIMATION OF RAINFALL,

P. Ryan.

J Hydrology, New Zealand, Vol 5, No 2, pp 100-110, 1966.

Descriptors: *Instrumentation, *Rainfall intensity. Identifiers: *Radar measurement, Calculations.

By calibration of equipment, power back-scattered to radar by precipitation can be measured; power back-scattered depends on reflectivity of precipitation, which in turn depends on form of drop-size distribution; rainfall rate is also function of drop size distribution, and empirical relationship exists between reflectivity and rainfall rate; using this relation, measurements of received power permit estimate of rainfall rate; trials conducted overseas suggest that accuracy of factor of two can be achieved with suitable equipment on all occasions. W69-02082

GAUGE FOR CONTINUOUSLY MEASURING RATE OF RAINFALL,

R. A. Semplak.

Rev Sci Instruments, Vol 37, No 11, pp 1554-8,

Descriptors: *Rain gages, Instrumentation. Identifiers: *Calculations.

In gage, water flows through channel type capaci-tor which is coupled to oscillator, thus frequency of output voltage changes with rain rate; calibration curve can be expressed mathematically as sum of

two exponentials; 100 gages were fabricated and calibrated, and statistics of these calibrations are presented; based upon measured data, capacitance rain gages are found suitable for situations where continuous rainfall rate data are desired; output of gage is in form readily adapted for computer reduction. W69-02083

AUSTRALIA DEVELOPS NEW SCIENTIFIC **EQUIPMENT** TO ASSESS WATER RESOURCES,

I. Stuart.

Water and Water Eng, Vol 70, No 850, pp 515-17, Dec 1966.

Descriptors: *Rain gages, Instrumentation. Identifiers: Australia.

Tilting bucket rain gage was developed and manufactured by Rimco, Melbourne; bucket, housed in standard 8 in. gage, tilts every time 0.01 in. of rain falls on it and tilting sends out electrical impulse which may operate counter located at gage or may be recorded on charts or tape either at gage or at distance; this gage bucket is gold-plated to reduce surface tension and to help water run more easily.

TV INSPECTION OF SEWERS IMPROVES REPAIR PROGRAM,

H. T. Thornquist Public Works, p 73, Feb 1966.

Descriptors: *Sewers, *Equipment. Identifiers: *Sewer inspection.

A miniature TV camera (used to inspect sewers 15 inches and smaller in diameter in Seattle, Wash.) is described in detail. Procedure for inspection is also described. An average day's inspection covers 1,200 ft. of sewer at an average cost of 19 cents/ft. The TV inspection has made it possible to extend the program of scheduled repairs. A savings of approximately 1/3 is estimated when repairs can be scheduled on a routine basis. W69-02085

RAINFALL RECORDERS-COMPARISON OF DIFFERENT TYPES,

H. W. Underhill.

Int Assn Sci Hydrology-Bul, Vol 11, No 3, pp 50-5, Sept 1966.

Descriptors: *Rain gages, Instrumentation, Siphons.

Comparison was made of available recording rain gages; practical experience with certain of these instruments showed that points of design which are of particular interest are clock mechanism, siphoning time and frequency, tipping time and frequency, in-ternal constrictions, dribbling siphon and verticality of pen travel. W69-02086

ELBOW METER MEASURES FLOW,

P. A. Vesilind, and F. E. McJunkin. Pub Works, Vol 98, No 12, pp 80-81, Dec 1967.

Descriptors: *Flow measurement, *Flowmeter, *Sewer hydraulics.

Elbow meter used for measuring flow rate of water in piping systems is described; any elbow in system may be used and it is not necessary to disassemble piping to install meter; elbow may be in any position--horizontal or vertical; pipe must be flowing full, however, during calibration and operation. W69-02087

AUTOMATIC MOBILE SAMPLING AND GAG-

R. B. Weidner, S. R. Weibel, and G. G. Robeck. Pub Works, Vol 99, No 1, pp 78-80, Jan 1968.

Descriptors: *Storm runoff, *Sampling, *Instrumentation, Automatic control.
Identifiers: *Urban drainage, *Urban hydrology.

Unit for sampling storm-water runoff from various environments on time-proportioned or flow-proportioned basis was developed by Cincinnati, Ohio, Water Research Laboratory to facilitate urban storm-water runoff studies; operation of sampler is dependent on sufficient amount of rainfall to start electrical and cooling systems, and predetermined amount of runoff to activate sampling section.

THROTTLE MEASURING DEVICE OF RAIN-WATER OVERFLOWS

For primary bibliographic entry see Field 04A. For abstract, see . W69-02100

MEASUREMENT OF STORM WATER OUT-LETS IN COMBINED SEWERS BY THE THROTTLE-PIPE PROCESS,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02112

AKRON MONITORS COMBINED SEWER OVERFLOWS,

E. Gates

Pub Works, Vol 98, No 1, pp 90-1, Jan 1967.

Descriptors: *Overflow, Instrumentation, Pumping, *Equipment.
Identifiers: *Combined sewers, *Interceptor sewers, Akron (Ohio).

Description of monitor and control units for combined sewer system (see Engineering Index 1963 p 716); basic equipment consists of Tel-Eye liquid contact sensors at pump stations and connections between storms and interceptors, Telstep telemetry units signaling over leased telegraph channel lines, and master panel at sewer maintenance headquar-

ters. W69-02130

HOW TO ANALYZE COMBINED SEWAGE-STORMWATER COLLECTION SYSTEMS, For primary bibliographic entry see Field 05A For abstract, see .

W69-02159

DEPOSITION IN A SANITARY SEWER, For primary bibliographic entry see Field 08A. For abstract, see. W69-02170

SEWERS CAN BE REBUILT BY REMOTE CON-

For primary bibliographic entry see Field 08A. For abstract, see W69-02173

RAINFALL AND EVAPORATION: DISTRIBU-TION IN SPACE AND TIME,

For primary bibliographic entry see Field 02D. For abstract, see. W69-02247

THE ROLE OF PARAMETRIC HYDROLOGY.

University College, Galway, Ireland. For primary bibliographic entry see Field 02A. For abstract, see. W69-02249

REMOTE SENSING OF WATER POLLUTION, Sacramento State College, Sacramento, California.

Leonard W. Hom.

J Water Pollut Contr Federation, Vol 40, No 10, pp 1728-1738, Oct 1968. 11 p, 7 fig, 1 tab, 7 ref.

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

Descriptors: *Remote sensing, *Water pollution, Electromagnetic waves, Infrared radiation, Mapping, Marking techniques, Measurement, Networks, Photography, Photogrammetry, Radar, Spectroscopy.

Identifiers: Remote sensing of pollution

Remote-sensing devices, primarily those based on imaging with portions of the electromagnetic spectrum, can be valuable tools for sensing water pollution and protecting water resources. Multiband spectral reconnaissance, in which information from several portions of spectrum is used to interpret the condition of land and water, is particularly useful because it enables the interpretor to identify a feature by its 'tone signature', the unique set of tones that feature will produce in the several bands in which it is imaged. Bands may include thermal infrared and radar, as well as more usual photo-graphic ranges. Other applications of remote sensing to water pollution may be made with microwaves, airborne magnetics, input electromagnetics, gamma-ray spectrometry, chemical vapor detection, and fluorescent processes. This method supplements, but does not replace, normal field methods W69-02285

LEGAL ASPECTS OF PENNSYLVANIA WATER RESOURCES PLANNING,
Pennsylvania State Univ., University Park. Institute for Research on Land and Water Resources.

Benjamin V. Dall.

Proceedings of the Water Resources Law Colloquium, Institute for Research on Land and Water Resources Information Report No 51 pp 1-14, July 1967. 14 p, 4 ref.

Descriptors: *Pennsylvania, Water law, Legal aspects, *Riparian rights, Surface runoff, Surface drainage, Base flow, *Groundwater, Judicial decisions, *Percolating water, Underground streams, Surface waters.

Policy questions regarding water are to be answered by integrating legal considerations into scientific analysis. Economics has always played an important role in water law. Water law in Pennsylvania, based on the doctrine of riparian rights, is similar to the other eastern states. Cases give the best reflection of water law. Pennsylvania has classified water according to its physical form: (1) natural watercourses and lakes; (2) surface waters; and (3) percolating ground waters. Each of these classifications involve different rules of law. A natural watercourse must have a definite channel and banks and must discharge itself into another body of water. Cases involving the question of what constitutes a watercourse are discussed. Riparian rights involve the use of water, not the ownership. Domestic and nondomestic uses are discussed. Underground streams are generally treated in the same way as surface streams. Surface waters have no definite course or substantial or permanent existence. Most cases concerning surface waters involve repeling them and there is not much question that consumption of surface waters is legal. The reasonable use doctrine has been adopted with regard to percolating waters. Constitutional problems suggested by the revision of water law by statute are mentioned. (Williams-Fla) W69-02324

RELATIVE ROLES OF LAW AND ECONOMICS IN THE FORMULATION OF WATER POLICY, Wyoming Univ. Frank J. Trelease

Proceedings of the Water Resources Law Colloquium, Institute for Research on Land and Water Resources Information Report No. 51, pp 15-23, July 1967. 9 p, 6 ref.

Descriptors: Prior appropriation, Benefits, Costs, Economic efficiency, Evaluation, *Economics, Cost-benefit analysis, *Water law, Administration, Water management (Applied), *Competing uses, Riparian rights, Water resources development, *Water policy.

Water law ideally should provide for maximum benefits through the granting of private property rights. These should be regulated only when private economic action does not protect the public interest. Property rights must be secure enough to en-courage development and still be flexible enough to change when economics so dictates. Since it is impossible to know just what the maximum benefits are, economics should only attempt to give direction toward the maximum benefits. The use of private property rights leaves the decisions as to the most productive and wisest uses in the hands of the owners, instead of having government make every decision. This leads to maximization without strict regulation. Water law must facilitate a shift from existing uses to new uses. The use of the economic marketplace is the best guarantee of flexibility. Of course, some regulation is necessary to insure protection of the public interest. The cost-benefit analysis should be used by public authorities to decide if the overall benefits of a proposed use out-weigh the overall costs. However, intangible factors can cause difficulties in the use of this type of analysis. Various reasons for having to superimpose at least some regulation on the market are discussed. The doctrine of riparian rights is criticized as not promoting a beneficial overall water policy. (Williams-Fla W69-02325

HUMIDITY SENSOR: PERMANENT ELECTRIC HYGROMETER FOR CONTINUOUS MEA-SUREMENT OF THE RELATIVE HUMIDITY OF THE AIR, Michigan State Univ., East Lansing.

George J. Bouyoucos, and R. L. Cook. Soil Science, Vol 100, No 1, pp 63-67, July 1965. 5 pp, 2 fig, 2 tab.

Descriptors: *Hygrometry, *Humidity, *Temperature, Electrical conductance, *Air, Electrodes, Electrical resistance, *Measurement, Calibrations, Evaporation, Instrumentation, Wetting, Drying. Identifiers: *Relative humidity, *Hydrocal, *Sen-

A new electric hygrometer was designed to measure relative humidity of the air. The hygrometer uses long and wide stainless steel electrodes cast in gray hydrocal. The hydrocal acts as a sensor and measures relative humidity electrically. Electrical resistance varies as relative humidity varies. Special conductivity bridges have been used in the gray hydrocal hygrometer to measure relative humidity by measuring its electrical resistance. The saturated salt method is used to calibrate the hygrometer. The unit has been subjected to a variety of climatic conditions for over one year without any significant change taking place in its calibration. Sensitivity of the unit can be varied by changing distance between electrodes. Temperature changes do not exert significant influence on the relative humidity measurement of the hygrometer. A significant fact is that the unit possesses a hygroscopic property that is not destroyed by washing with distilled water. The hygrometer can be used in arid climates to measure relative humidity of the air, which is an indication of evaporation when formu-las such as Penman's are used. (Blecker-Ariz) W69-02374

COMPARISON OF WATER POTENTIALS IN LEAVES AS MEASURED BY TWO TYPES OF THERMOCOUPLE PSYCHROMETER,

CSIRO, Griffith, N.S.W., Australia, Irrigation Research Laboratory. For primary bibliographic entry see Field 02I. For abstract, see .

W69-02375

W69-02382

WATER LEVEL **FLUCTUATION EVAPOTRANSPIROMETERS**,

U. S. Geological Survey, Phoenix, Arizona. Water Resources Div. For primary bibliographic entry see Field 02D. For abstract, see .

REMOTE SENSING FOR ESTIMATING SOIL SALINITY

Agricultural Research Service, Soil and Water Conservation Research Div.

Victor I. Meyers, David L. Carter and William J.

J. Irrig and Drain Div. ASCE. Vol 92, No IR 4, Proc Paper 5040, pp 59-68, Dec. 1966.

Descriptors: Arid lands, *Remote sensing, *Saline soils, Water table, *Aerial photography, Salt tolerance, *Temperature, Leaves, Cotton, *Infrared radiation, Crop response, Sampling.

Many soils in arid areas of the world are affected by high water tables and resultant soil salinity. Detection of the saline areas and of the degree of salinity in the rooting profile is of considerable interest to agricultural workers involved in reclamation of these soils. Cotton was used as an indicator plant to relate the salinity in the 0 to 5 ft. profile at some reference locations to that at a number of prediction sites where the salinity was unknown. Aerial photographs were taken using ektachrome infra red aero film for observing the salinity-affected cotton. On the basis of color tones it was possible to distinguish five levels of salinity. Infra red radiometer measurements of cotton leaf temperatures were made on the ground and from an airplane. Statistical studies of the temperature data taken on the ground indicated that soil salinity could be predicted from cotton leaf temperatures with reasonable accuracy. (Affleck-Ariz) W69-02385

7C. Evaluation, Processing **AND Publication**

SEWER DEPTH OF FLOW DETERMINATION, Robert C. Wilging.

Water and Sewage Works, Vol 109, 103, March 1962

Descriptors: *Sewers, Pumping, Manholes, *Flow measurement, Storm runoff Identifiers: Storm sewers, *Capacity.

A procedure to determine the present sewer capacity available to receive pumped sewage from adjacent areas is described. Sticks, one by one inch, grooved on one side and provided with glass vials were placed in selected sewer manholes. Appropriate numbers of vials, regularly checked, provided information of the maximum flow occurring in the period between readings. Information on the influence of rainfall on the flow of sewers in certain areas not served by storm sewers was collected. The information obtained helped to place pumped sewage in areas where sewers were not overloaded even after heavy rainy conditions. W69-02089

THE STORAGE AND DISCHARGE CAPACITIES OF SEWERAGE AND THE OPERATING FREQUENCY OF STORM OVERFLOWS: DUTCH METHOD OF CALCULATION, For primary bibliographic entry see Field 04A. For abstract, see .

ON MEASUREMENTS OF STORM-SEWAGE OVERFLOWS - A GRAPHICAL METHOD, For primary bibliographic entry see Field 04A. For abstract, see . W69-02111

THE EFFECT OF DELAYED DISCHARGE ON THE CALCULATION OF STORM-SEWAGE OVERFLOWS, For primary bibliographic entry see Field 04A. For abstract, see .

W69-02120

NEW PRINCIPLES FOR THE ARRANGEMENT OF STORM WATER OVERFLOWS,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02149

NEW PROCESS FOR SIMPLE CALCULATION OF DILUTION VALUES FOR STORM WATER OVERFLOWS IN COMBINED SEWERAGE SYSTEMS.

For primary bibliographic entry see Field 04A. For abstract, see . W69-02150

SOLUTION FOR STORM SEWER SYSTEM PROBLEM,

For primary bibliographic entry see Field 02E. For abstract, see . W69-02186

THE APPLICATION OF STORAGE CAPACITY TO THE DESIGN OF SEWERS,

For primary bibliographic entry see Field 08A. For abstract, see . W69-02194

SIMPLIFIED SEWER DESIGN.

For primary bibliographic entry see Field 08A. For abstract, see . W69-02198

EMPIRICAL MODEL FOR PREDICTING DRAINAGE SYSTEM PERFORMANCE.

For primary bibliographic entry see Field 04A. For abstract, see . W69-02201

DESIGN OF STORM SEWER SYSTEMS,

For primary bibliographic entry see Field 02E. For abstract, see . W69-02204

ROLE OF DIGITAL COMPUTERS HYDROLOGIC FORFCASMUTERS IN AND

ANALYSES,
J. P. McCallister.

Int Geodetic and Geophysical Union-Sec for Sci Hydrology Publ, No 63, pp 68-76, 1964. 3 charts.

Descriptors: *Computer programs, *Rainfall-runoff relationships, *Runoff forecasting, Hydrographs.
Identifiers: *Calculations.

Major goal of river forecasting computer model is to conserve as much continuity as possible between forecaster and his forcast product; computer will provide mathematically exact computation; four hydrologic subroutines required to develop forecast program are rainfall-runoff computation, unit graph computation, stream flow routing and reservoir routing. W69-02245

STUDY OF R R L HYDROGRAPH METHOD OF **DESIGNING SEWER SYSTEMS,**

E. G. W. Oliver. Chartered Mun Engr, Vol 90, No 12, pp 377-82, Dec 1963.

Descriptors: *Hydrographs, *Design, *Sewers, Rainfall intensity, Outlets. Identifiers: *Calculations.

Hydrograph method of design considers changing situation over drainage area and in network of sewers at equal intervals of time, usually of one minute; calculation reflects minute-by-minute variation in contributing area, rainfall intensity and volume of water stored; flow diagram, or hydrograph, is evaluated and rate of flow at outfall is shown after each minute; comparison is made with conventional rational method.

COMPARISON OF SOME FORMULAS FOR DETERMINING THE SNOW MELT (PRELIMI-NARY RESULTS).

For primary bibliographic entry see Field 02E. For abstract, see . W69-02252

ON THE IMPORTANCE OF VOLUME DIS-TRIBUTION IN THE CALCULATION OF DRAINAGE SYSTEMS,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02254

USE OF ANALOG MODELS IN ANALYSIS OF FLOOD RUNOFF.

For primary bibliographic entry see Field 02E. For abstract, see . W69-02261

DOUBLE-MASS ANALYSIS ON COMPUTER.

For primary bibliographic entry see Field 02B. For abstract, see . W69-02263

REAL-TIME DIGITAL PROCESSING OF UN-STEADY-FLOW VARIABLES,

Iowa Univ., Iowa City, Iowa Institute of Hydraulic

John R. Glover, and Arthur R. Giaquinta. J Hydraul Res, Vol 6, No 3, pp 219-232, 1968. 14 p, 2 fig, 5 ref.

Descriptors: *Analog computers, *Digital computers, *Data processing, Computer programs, Data transmission, Programming languages. Identifiers: Analog-digital conversion.

The application of digital computers to the handling of unsteady-flow variables usually collected in analog form is discussed. The conversion of analog to digital data by the IBM 1801 Data Acquisition System is described and the effect of time of conversion on precision of translated data is discussed. Programming languages both for conversion and processing of data are discussed with particular reference to their usefulness for hydrologic work and their efficiency with respect to a professional programmer's needs. (Knapp-USGS) W69-02288

AUTOMATIC PROCESSING OF CURRENT

METER DATA, Laboratoire d' Hydraulique de Toulouse, et Laboratoire associe an Centre National de la Recherche Scientifique, Toulouse, France. L. Castex, J. Piquemal, and H. Saby J Hydraul Res, Vol 6, No 3, pp 211-218, 1968. 8 p,

Descriptors: *Instrumentation, *Current meters, *Computers, Digital computers, Measurement. Identifiers: *Digital recorders, Analog-digital con-

A system for the automatic processing of currentmeter data is described. The equipment is fully portable and suitable for both field and laboratory use. As many channels are used as current meters. The current-meter signals are converted to digital information displayed on a panel. A gaging operation involving measurement of 270 velocity points each taking 200 sec to record can be completed by one operator in about 2 hours. (Knapp-USGS) W69-02291

SIMPLIFICATIONS OF GROUND-WATER DATA USED FOR AN ANALOGUE OF A COASTAL AQUIFER,

Water Research Assoc., Medmenham. Buckinghamshire, England.

A. Hunter Blair. Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 59-65, Sept 1968. 7 p, 5 fig, 3 ref.

Descriptors: *Analog models, *Saline water intrusion, *Aquifers, *Saline water-freshwater interfaces, Steady flow, Non-uniform flow, Drawdown. Identifiers: Lincolnshire (England), Chalk aquifer.

An electric analog model study was made of the chalk aquifer of North Lincolnshire, England. The aquifer is about 300 ft thick and dips east. The western part crops out and the eastern part is confined by glacial deposits. In the study area, on the east coast of England, overpumping has caused some salt water intrusion. Transmissibility was determined by pumping tests and compared with T values estimated from regional water table slopes and total discharge. A steady state model of 1500 nodes, modeling about 300 sq mi, was constructed with a mesh spacing of 0.5 mi. The model was adjusted to agree with observed water levels. A nonsteady state model was made, representing a flow band across the southern half of the steady state model, to study the relationship between applied pumping rate, position of the well relative to the coast, and applied infiltration. To simplify the problem it was necessary to assume uniform infiltration, steady pumping rate when the pump was on, vertical saltfresh water interface, no zone of mixing, equal viscosity, and no lateral flow. It was found that beyond 440 ft from the coast, 90-100% of infiltration may be pumped without salt water intrusion. Maximum encroachment occurs at a well 0.5 mi from the sea. When total pumpage is held to 90-100% of infiltraton, pumping rate had no significance on net encroachment of saline water. (Knapp-USGS) W69-02344

NUMERICAL STUDIES DISPERSION IN ESTUARIES, OF UNSTEADY

Massachusetts Institute of Technology, Cambridge, and Gibbs and Hill, Inc., Boston, Massachusetts. For primary bibliographic entry see Field 02L. For abstract, see . W69-02346

A MATHEMATICAL MODEL FOR TRANSIENT FREE SURFACE FLOW IN NONHOMOGENE-OUS OR ANISTROPHIC POROUS MEDIA, Acres Ltd., Niagara Falls, Canada.

B. A. Szabo, and I. W. McCraig. Water Resources Bull, Vol 4, No 3, pp 5-18, Sept 1968. 14 p, 8 fig, 2 tab, 13 ref.

Descriptors: *Model studies, *Analog models, *Computer models, *Mathematical models. *Porous media, Free surfaces, Water table, Drawdown, Anisotropy, Darcys law, Dupit-Forcheimer

A mathematical model was developed to solve a steady free surface flow problem and a rapid drawdown problem in a two-dimensional porous medium. The same problem was also solved by an analogue device and excellent agreement was found to exist between the two solutions. This paper contains the formulation of the numerical problem from first priniciples and a discussion of measures that had to be taken in order to assure numerical stability and proper convergence of the solution. Although the scope of this study was limited to a two-dimensional flow case, the elements of simulation discussed are general in nature and applicable to three-dimensional problems. It was demonstrated that numerical solutions can be obtained for the position of the free surface at given time intervals, for the piezometric head dis-tribution within the flow field and for flow quantities across given boundaries. In addition, the mathematical model will permit consideration of

Field 07—RESOURCES DATA

Group 7C—Evaluation, Processing and Publication

nonhomogeneous or anisotropic characteristics of the porous medium, without difficulty. It is concluded that mathematical models in conjunction with analog control devices can be efficient and reliable tools for solving complex porous flow problems. (Author) W69-02353

08. ENGINEERING WORKS

8A. Structures

IN RE LAKE SADAWGA DAM (ADMINISTRATIVE JURISDICTION OVER CERTAIN DAMS). 159 A 2d 337-340 (Vt 1960).

Descriptors: *Vermont, *Administrative agencies, *Jurisdiction, *Dams, Judicial decisions, Administrative decisions, Water law, Adjudication procedure, Legislation, Safety, Water levels, Spillways, Height, Width, Outlet works, Hydroelectric power, Supervisory control (Power), Ponds. Identifiers: Presumptions, Evidence.

The owner of a dam appealed from an order of the State Water Conservation Board requiring him to make specified changes in the height and width of the spillway for safety reasons. The water conservation board had jurisdiction over certain dams and the public service commission over certain others. The court held that under such circumstances, jurisdiction must affirmatively appear in each case. Although an appellate court is generally required to assume that a court of general jurisdiction regularly acquired and lawfully exercised its jurisdiction, no such presumption arises where the lower court is one of limited or special jurisdiction. A public administrative body has such jurisdiction as is conferred on it by statute, and the board must determine and make findings of the facts necessary to show that the power it exercised did exist. Since the board made no jurisdictional finding supported by the evidence, it had no basis for issuing its order, and consequently, the order was invalid. It was further held that an order should be directed to a condition which exists at the time the order is entered, and not at the time of the initial proceedings. (Smodish-Fla) W69-02044

SOUTH SASKATCHEWAN RIVER PROJECT, For primary bibliographic entry see Field 03F. For abstract, see . W69-02076

STORM SEWER TUNNEL 'THREADS NEEDLE' BETWEEN HIGHWAY BENTS, W. D. Murphy.

Pub Works, Vol 95, No 8, pp 95-6, Aug 1964.

Descriptors: *Tunnel construction, *Drainage, *Storm runoff, Highways. Identifiers: *Storm sewers, Houston (Texas).

Techniques described were used in project for Texas Highway Dept; 11 1/2-ft boring machine was pushed 6500 ft passing between 75 sets of proposed freeway columns with tolerance of 18 in. on either side; tunnel was bored under downtown Houston on sewer project which required 6947-ft long, 8 1/2-ft ID monolithic concrete storm sewer to carry drainage water from depressed section of Highway 59 near center of city.
W69-02077

DOUBLE-BARRELED CLAY-PIPE SEWER, Lyall A. Pardee. Amer City, pp 82-83, Dec, 1966.

Descriptors: *Sewers, *Construction, *Velocity, *Corrosion, Design.
Identifiers: Los Angeles (Calif.).

A sewer line consisting of two 42 in. clay pipelines running parallel in a common trench reinforced with concrete bedding cradles was designed to solve a corrosion problem in the Los Angeles area. It replaced 7,838 feet of a reinforced concrete pipe sewer lined with clay plates that was subject to acid attack. The section replaced was part of a gravity line following a steep grade. A combination of the high-velocity flow and H2SO4 concentration caused corrosion of the concrete at a rapid rate. Design and construction of the new clay pipeline are briefly discussed. W69-02079

MODEL INVESTIGATIONS OF DIFFERENT TYPES OF STORM-WATER OVERFLOWS AND THEIR EFFECT ON THE SEWAGE WORKS AND THE RECEIVING STREAM,

For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02091

THE PERFORMANCE OF STILLING PONDS IN HANDLING SOLIDS,

M. R. Frederick.

In Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Stilling basins, Storm runoff, Discharge (Water), *Weirs, Design, Siphons, Equipment.
Identifiers: *Suspended solids, Capacity.

The total capacity of a stilling pond may be sufficient to prevent discharge in storms of short duration and moreover, the solids dislodged from the sewer in the early part of the storm flow may be retained and passed into the sewer when flow subsides. The behavior of gross solids was investigated to determine how the pond may be proportioned to minimize the quantity of solids in the discharge. The essential features of the type of stilling pond under consideration are illustrated, as well as the form and action of the air-regulated siphon and the water circuit. The experiments were arranged first to establish a valid technique on a pond of specified geometry, and then to use this technique to examine and develop geometrical shapes which appeared to offer the possibility of high efficiency. Tests were made to compare the performance of a rectangular stilling pond with that of a side weir and that of a fan-shaped chamber with an end weir. The rectangular design is shown to be superior in its handling of gross solids. From the tests and with VC (1/2)D/U as a parameter, recommendations are given for design dimensions of: (a) pond size, (b) siphon type and position, (c) scum board size, and (d) invert shape. The efficiency of a pond thus designed may be obtained from given curves.

STORM-WATER CONTROL BY SIPHON SPILLWAYS AT EARLSWOOD SEWAGE WORKS, REIGATE,

For primary bibliographic entry see Field 04A For abstract, see . W69-02095

W69-02092

W69-02096

TESTING AND CALIBRATION OF STORM OVERFLOW CONTROL PIPES, For primary bibliographic entry see Field 04A. For abstract, see .

TESTS ON A MODEL STILLING POND WITH SIPHON OVERFLOW,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02097

THE DESIGN AND EFFICIENCY OF STORM WATER OVERFLOWS IN COMBINED SEWERAGE SYSTEMS,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02102

PRACTICAL DESIGN OF STORM SEWAGE OVERFLOWS,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02107

STORM-WATER OVERFLOWS: THE OPERA-TION AND DESIGN OF A STILLING POND, For primary bibliographic entry see Field 04A. For abstract, see . W69-02113

THE TREATMENT OF STORM SEWAGE, For primary bibliographic entry see Field 05D. For abstract, see . W69-02116

PROBLEM OF DESIGN OF INTERCEPTING DEVICES WITH OVERFLOW WEIRS IN COMBINED SEWER SYSTEMS,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02117

HOW TO PLACE STORM SPILLWAY IN COM-BINED STORM AND SANITARY SEWER SYSTEM.

For primary bibliographic entry see Field 04A. For abstract, see . W69-02118

POLLUTION CONTROL FOR STORM WATERS AND COMBINED SEWER OVERFLOWS, For primary bibliographic entry see Field 04A. For abstract, see . W69-02127

TROUBLE-FREE COMBINED SEWERAGE SYSTEMS,

L. B. Escritt.

Survr, Vol 113, p 603, July 17, 1954.

Descriptors: Sewers, Pipes, *Storm runoff, *Velocity, Design.
Identifiers: *Combined sewers, *Capacity.

The author presents both the valid and 'fallacious' arguments for the preference of separate over combined sewerage systems. He repudiates the most commonly given reasons for not using combined system; that is, that the large size pipes necessary for the storm flow will be silted during dry weather flow and if the gradient is increased to bring the dry weather flow to self-cleansing standards, excessive depth will result. He points out 'that, while increase of diameter above that required for the flow does usually reduce velocity, this reduction is very small indeed, so that in the majority of instances a combined sewer has a satisfactory self-cleansing gradient if it is laid to the same gradient as would be adopted for the soil sewer if the system were to be made separate.' An example is given.

W69-02128

THE ENGINEERING PROBLEM OF BALANCING RATE OF FLOW AND STRENGTH OF SEWAGE,

L. B. Escritt. Survr, Vol 104, p 221, 1945.

Descriptors: Design, *Weirs, *Sewage treatment, *Storm runoff.
Identifiers: *Storage tanks.

The design of weirs for separating storm water to be given partial treatment is discussed. Discussed design of storm water tanks having a 6-hour dry weather flow capacity. W69-02129

INTERCEPTING SEWERS AND STORM STANDBY TANKS AT COLUMBUS, OHIO, For primary bibliographic entry see Field 04A. For abstract, see

W69-02132

COMBINED SYSTEM OF SEWERAGE WITH LIMITED RAW WATER INLET,

For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02133

ADVANTAGES AND PROBLEMS OF COMBINED SEWERAGE SYSTEMS,

For primary bibliographic entry see Field 04A.
For abstract, see
W69-02138

SEPARATE SYSTEMS-COMBINED SYSTEMS, For primary bibliographic entry see Field 05D. For abstract, see . W69-02139

THE TRUNK SEWER SYSTEM AND THE SEWAGE-TREATMENT PLANT OF THE TOWN OF UTRECHT. HISTORY AND TECHNICAL LAY-OUT

CAL LAY-OUT, For primary bibliographic entry see Field 05D. For abstract, see . W69-02140

PROGRESS REPORT-ASCE COMBINED SEWER SEPARATION PROJECT,
M. B. McPherson.

Civ Eng, Vol 37, No 12, pp 61-2, Dec 1967.

Descriptors: Pumping, *Design, *Equipment, Velocity, *Head loss, *Pressure conduits, Pipes, Sewage treatment.

dentifiers: *Combined sewers, *Sewer separation,

Residential sewers.

General concept for separation of combined sewerage systems involves pumping comminuted or ground sewage from individual buildings through pressure tubing to new and separate sanitary sewage pressure conduits to treatment works; investigation of existing comminutor installations; research to establish design criteria for minimum transport velocities of sewage in pressure pipes; research on head losses for pipe within combined sewer; field investigations into feasibility of inserting pressure tubing in existing building sewers; etting of contracts to develop household grinder-storage-pump units and hanger system for suspending pressure conduit in combined sewers.

ASCE COMBINED SEWER SEPARATION PROJECT PROGRESS, M. B. McPherson.

Conference Preprint 548, American Society of Civil Engineers National Meeting on Water Resources Engineering, New York, NY, Oct 16-20, 1967. 21 p, refs.

Descriptors: Overflow, Velocity, Computer programs.

dentifiers: *Sewer-within-sewer, *Combined ewers, *Sewer separation.

Over 100 persons, including staff members of varibus subcontracting organizations, are actively stulying the 'sewer-within-sewer' concept of combined sewer separation, of pumping ground sewage from individual buildings through relatively small pressure tubing. Experimental and field data are being collected on grinding and pumping devices, installation of tubing in shallow trenches in place of non-walk-through sewers, types of tubing and connections, effect of installation on sewer surcharge capacity, transport velocity, and computer simulation, among others. About two dozen reports are expected, including some on concomitant solid waste disposal, and home-owner acceptability. W69-02142

FEASIBILITY OF COMBINED SEWER SYSTEMS,

For primary bibliographic entry see Field 04A. For abstract, see . W69-02146

UNDERFLOW SEWERS FOR CHICAGO, For primary bibliographic entry see Field 04A. For abstract, see . W69-02151

A BRIEF HISTORY OF POLLUTION PROBLEMS AND POLLUTION CONTROL IN THE CITY OF LONDON, ONT, For primary bibliographic entry see Field 05B.

For abstract, see . W69-02157

W69-02161

A FLOODED-TUNNEL INTERCEPTOR SYSTEM FOR THE METROPOLITAN ST. LOUIS SEWER DISTRICT,

For primary bibliographic entry see Field 04A. For abstract, see .

ONE CITY'S APPROACH TO THE PROBLEM OF COMBINED SEWAGE OVERFLOWS, For primary bibliographic entry see Field 04A. For abstract, see .

CORRECTING STORM-WATER INFILTRA-TION, TONAWANDA, NEW YORK,

Newell L. Nussbaumer. Sewage and Industrial Wastes, Vol 28, pp 977-82, Aug 1956.

Descriptors: *Surface runoff, *Storm drains, Sewers, *Design, Construction, Construction costs. Identifiers: *Storm sewers, *Sewer infiltration, Tonawanda (NY).

The article describes the layout and construction of the early sewers in Tonawanda, N.Y. Improper planning, poor construction, lack of storm sewers, and the diversion of surface water into the sanitary sewers caused flooding of the sanitary sewers during periods of precipitation. Increased tributary population intensified sewer problems. Several attempts were made to remedy the situation. In 1945 a comprehensive storm drain plan was developed to eliminate the excess water from the sanitary sewers. The types of storm sewers used, design criteria, construction details, and costs are outlined. W69-02165

LOW PRESSURE AIR TEST FOR SANITARY SEWERS, R. E. Ramseier.

ASCE Proc, J Sanit Eng Div, Vol 90, No SA2, pt 1, paper 3883, pp 1-29, April 1964.

Descriptors: *Sewers. Identifiers: *Leak detection, Sewer infiltration.

Effect of moisture on permeability of vitrified clay sewer pipe and its effect on testing procedure; specifications for testing new pipe installations are suggested, and methods of computing time necessary to meet specifications for single size pipe and for combinations of various size pipes are given; field tests show that pipe without detectable failure will lose less than 0.003 cu ft of air/min/sq ft of internal pipe surface, and that any air loss exceeding 2 cu ft/min can be located. W69-02167

EXPERIENCE IN USING LOW-PRESSURE AIR TEST FOR SANITARY SEWERS, R. E. Ramseier, and G. C. Riek.

Water Poll Control Fed J, Vol 38, No 10, pp 1623-33, Oct 1966.

Descriptors: *Sewers. Identifiers: *Leak detection, Sewer infiltration.

Low-pressure air test for sewer leakage has proved reliable, easy to use, and inexpensive; test, for which specifications have been developed, consists of introducing air into plugged section of pipe and measuring time needed for pressure to be reduced from 3.5 to 2.5 psi (0.24 to 0.18 kg/sq cm); nomograph is used to compute time acceptable according to specifications; increased wetness of pipe wall reduces air leakage through pipe-wall permeability, whereas increased pressure gradient between inside and outside of sewer increases leakage. W69-02168

LOW PRESSURE AIR TEST FOR SANITARY SEWERS.

Roy E. Ramseier, and George C. Riek. ASCE Proc, J Sanit Eng Div, Vol 90, No SA2, Pt 1, p 1, April 1964.

Descriptors: *Sewers, Maintenance. Identifiers: *Leak detection.

Testing a sewer pipe for leakage by the use of air at pressures of approximately 3 psi can measure effectively the quality of the installation. New work can be tested by noting the time required for pressure in a closed section of the pipe to drop from 3.5 psi to 2.5 psi. Where significant leakage is present, it can be quantitatively determined by metering the amount of air required to maintain a pressure in the test section. The effect of moisture on the permeability of vitrified clay pipe and its effect on the testing procedure is determined. Specifications for testing new pipe installations, are suggested, and methods of computing time necessary to meet specifications for a single size pipe and for combinations of various size pipes are given. Field tests show that pipe without a detectable failure will lose less than 0.003 ft (3) of air per min per ft (2) of internal pipe surface and that any air loss exceeding 2.0 ft (3) per min can be located. W69-02169

DEPOSITION IN A SANITARY SEWER, C. H. Raths, and R. F. McCauley. Water and Sewage Works, Vol 109, p 192, 1962.

Descriptors: *Deposition (Sediments), *Sewers, Design, Construction. Identifiers: *Suspended solids.

An investigation into deposition in sanitary sewers is described. In each experiment, an 8-in pipe line was set at the required slope a uniform flow of sewage was produced and sand of known particle size was introduced at 8-ft intervals, in descending order of size. From the results which are shown in tables and graphs, an equation was developed to express the relation between the depth of flow, the largest size particle to pass successfully through the pipe, and the slope of the pipe. It was also found that solids suspended in the sewage apparently had little effect on deposition and that pipe joints were the principal influence in initiating deposition. It is concluded that in designing a sewer more emphasis should be placed on joints and construction techniques than on minimum pipe grades.

W69-02170

Field 08—ENGINEERING WORKS

Group 8A—Structures

REHABILITATION OF SANITARY SEWER LINES,

D. E. Rhodes

Water Poll Control Fed J. Vol 38, No 2, pp 215-19,

Descriptors: *Sewers, Construction, Sealants. Identifiers: *Sewer infiltration, *Leak detection,

Excessive infiltration into sanitary sewer lines caused by faulty construction was problem in Montgomery County, Ohio; injection-type sealing with polymer-type grouting fluid applied within line seems to have reduced infiltration substantially; TV inspection located leaks and wastewater was diverted around plugged-off section; TV also was used for setting of packer over leaks. W69-02171

SEWERS CAN BE REBUILT BY REMOTE CON-

George Rutz.

Water Works and Wastes Eng, Vol 2, pp 42-43, Oct 1965.

Descriptors: *Sewers, *Sealants. Identifiers: *Leak detection.

Sewer system leaks in approximately 3,000 ft of sewer were located by a closed-circuit television camera and then sealed with chemical 'gel' by a grouting machine. The units operated from within the sewer and were controlled remotely from the surface. The TV camera provided a view of the sealing process while it was being undertaken. W69-02173

INFILTRATION IN SANITARY SEWERS.

I. W. Santry, Jr.

J Water Poll Control Fed, Vol 36, p 1256, Oct

Descriptors: Sewers, Construction. Identifiers: *Sewer infiltration.

This paper points out the importance of infiltration in sanitary sewers. The degree of infiltration is influenced by such variables as climate, soil characteristics, ground water table position, materials of construction, vegetation, and the existence of illegal connections. In this investigation submergence tests were made on clay and concrete pipe using jute, cement, cold mastic, hot pour asphalt, rubber gasket, and PVC jointing materials. It was indicated that the newer joints have much less infiltration than the older ones. The author stresses the importance of building sewers with materials that will slow down infiltration, with joints that will stay tight and with bedding and backfill conditions that will prevent future movement of the pipe. Illegal connections should be eliminated. W69-02174

STORM SEWER DESIGN BY THE INLET METHOD.

For primary bibliographic entry see Field 04A. For abstract, see W69-02179

USE OF 3m DIAM REINFORCED CONCRETE STORM SEWERS FOR WESTERN SIBERIAN METALLURGICAL PLANT, SOVIET UNION, G. E. Korotkovskii, Yu M. Sedel'nitskii, and M. M.

Beton i Zhelezobeton, No 9, pp 8-12, Sept 1967.

Descriptors: *Design. Identifiers: *Storm sewers, Russia.

Use of 3 m diam reinforced concrete storm sewers for Western Siberian Metallurgical Plant, Soviet Union; transverse reinforcement in 3 m sewers must be designed under high loads considering resistance of transverse and shearing force by concrete and reinforcement; each annular rod in tension zone should be fastened by ties; side earth pressure up to 20% of vertical load leads to increase of bearing capacity of sewer and should be considered during design; good agreement between theoretical and experimental values. In Russian. W69-02180

LEAVES WON'T CLOG THIS CATCH BASIN,

R E Lanar

Pub Works, Vol 95, No 3, pp 90-1, March 1964.

Descriptors: *Storm runoff, *Intakes, Design. Identifiers: *Storm sewers, Urban drainage.

Storm sewer project, in Poughkeepsie, NY, required new design for street catch basins which incorporates depressed stream flow grate with extra wide curb opening; grating used has distinct advantage of offering tear-drop construction of cross-bars which minimizes tendency to retain leaves at surface and induce clogging. W69-02182

HOW TO SIZE CONDUITS FOR STORM SEWERS,

Chesman A. Lee

Chem Eng, Vol 67, No 20, pp 97-8, Oct 3, 1960.

Descriptors: Sewers, *Design, *Overflow. Identifiers: *Storm sewers, *Manning formula.

A chemical plant must be supplied with storm as well as sanitary sewers. In general, sewers are designed to operate only partially full-quite different from the techniques of operating pipe lines full and under pressure. The Manning formula is discussed in considerable detail. A storm sewer may be designed to operate full and overflowing under the worst conditions. The fact that the sewer is under pressure need cause no concern since at times of heavy rains the soil is saturated and provides an opposing pressure. A problem and its step-by-step solution is given to illustrate methods used to provide design data. W69-02184

STORM SEWER TUNNELING IN SANDSTONE, K. K. McRae

Pub Works, Vol 98, No 2, pp 110-11, Feb 1967.

Descriptors: *Tunnel construction. Identifiers: *Storm sewers.

Features of tunneling in St. Paul and Minneapolis. Minn; normal stratigraphic sequence from surface down is-glacial drift (mixed silts, sands, clays, shales and boulders), Platteville Limestone, Glenwood Shale and St. Peter Sandstone; procedure in advancing tunnel was to direct h-p water at face to erode sandstone into sand slurry; mining water was obtained from dewatering wells and carried to machine in 8 in. pipe, passed through jet pumps, and directed at face through 1/4-in. diam nozzles mounted on hand lances; cutting pressure developed at pump was 400 psi; for tunnel lining modified type 3 grade Y concrete is used by concrete pumping machine; overall footage normally averages from 30 to 50 ft in 8-hr shift. W69-02187

STORM SEWER SYSTEMS,

American Public Works Assoc Res Foundation. Herbert G. Poertner.

State and Local Public Facility Needs and Financing Subcommittee on Economic Prog of the Joint Economic Committee - Congress of the US - Vol I, Public Facility Needs, pp 152-174, Dec 1966, 5 fig, 7 tab.

Descriptors: *Design. Identifiers: *Storm sewers.

A broad study of storm sewer systems is presented. Characteristics, functions, and basic principles are discussed as well as standards of performance and design. The existing capital plant of storm sewers is described. History, distribution, age and ownership are all discussed and statistics are given. Costs, charges and benefits are described. Trends of capital outlay are discussed. Graphs show annual U. S. sewer pipe requirements for various size pipes. Expenditures by private land developers and public agencies are discussed. Sources of financing are outlined. Needs, prospective capital outlays and sources of funds for 1966-75 are discussed.

CALCULATION OF RETENTION TANKS IN STORM-WATER SEWERS,

R. Randolf.

Wasserw-Wass Techn, Vol 9, p 148, 1959.

Descriptors: *Storm runoff, Drainage systems. Identifiers: *Capacity, *Storage tanks, *Calcula-

The author discusses, with practical examples, the calculation of size of retention tanks on stormwater drainage systems. W69-02191

SPLIT LEVEL DESIGN FOR SEWER SEPARA-

TION, W. G. Ridge. Pub Works, Vol 97, No 11, p 97, Nov 1966.

Descriptors: *Sewers, *Construction, *Tunnels, *Storm runoff. Identifiers: *Storm sewers, *Sewer separation.

Installation of sanitary sewers at invert of previously used combined sewer system; four cuts were made into 102-in, sewer and 10 to 12-ft long corrugated steel pipe sections were lowered with setting into position by fork-lift truck working inside sewer; sanitary sewer was of elliptical section; after placement, corrugated pipe was grouted with concrete to provide smooth flow for storm water; corrugated sanitary sewage pipe has been handling average flow of 25 million gpd, and storm water capacity in modified tunnel is 500 cfs.

W69-02192

THE APPLICATION OF STORAGE CAPACITY TO THE DESIGN OF SEWERS,

E. J. Sarginson. Survr, Vol 119, p 215, 1960.

Descriptors: *Design, *Hydrographs. Identifiers: *Storm sewers, *Capacity, Calcula-

The author shows how calculations involving the storage capacity of circular sewers can be applied to reduce the size of the conventional storm-water sewer, dealing particularly with the effect of the shape of the hydrograph of flow into the pipe on the rate of flow out of the pipe. It is suggested that reduction of pipe diameter to less than conventional size should be confined to the lower larger parts of a sewerage system. W69-02194

STORM SEWER DESIGN FACTORS,

Amer City, Vol 79, p 76, July 1964.

Descriptors: *Design, Discharge (Water), Drainage, *Flow measurement, *Rainfall intensity, *Runoff, *Intakes. Identifiers: *Storm sewers, *Urban drainage.

An approach to the determination of design discharges for storm sewers in Puyallup, Wash. is discussed, wherein the runoff coefficient to be used, and the actual contributing area within the given drainage area is determined by actual flow measurements to a curb inlet, with the resultant flow being related to recorded rainfall intensities.

Results of the experiments revealed justification for considering only the street rights of way as the contributing drainage area, and the assignment of a 0.9 runoff coefficient to this area, for purposes of design discharge calculations. Such examination of actual runoff conditions, as opposed to the arbitra-ry selection of a runoff coefficient times a total contributing drainage area, is reported to have saved the city some 20 per cent on a million dollar storm sewer project. W69-02195

FUNDAMENTALS OF SEWER DESIGN,

Hydrocarbon Processing and Petroleum Refiner, Vol 43, No 10, pp 171-6, Oct 1964.

Descriptors: *Design, *Sewers. Identifiers: *Storm sewers.

Four basic sewer systems used in typical hydrocarbon processing plants are oily water sewer, acid (chemical) sewer, storm water sewer and sanitary sewer; ues., W69-02196 ewer; design and operation of each type.

SIMPLIFIED SEWER DESIGN.

R. B. Stevtler

Pub Works, Vol 91, p 102, June 1960.

Descriptors: *Sewers, *Design, Drainage systems, Rainfall intensity.

Identifiers: *Storm sewers, *Capacity, *Calculations, Erie (Pa.), *Urban drainage.

This article points out the necessity for revamping and extending the sewer system of the City of Erie, Pennsylvania, due to the growth in population and expansion of the area served by the system in recent years. The earlier designing did not take into consideration the future potential of the drainage areas, a situation which is typical in a number of communities. A simplified sewer design method was developed for use in extending and modifying the storm and sanitary sewer systems in the city which, according to the author, has proved effective and time saving both in original design and for checking of the existing system. The method consists of equating area to quantity of both sanitary and storm flow and superimposing the information on any one of a number of sewer design charts available. In this case a diagram based on Kutter's formula (n = 0.013) was selected. Basic sewer design principles are discussed together with development and adaptation of this design method. Drainage areas for both sanitary and storm drainage are plotted on the sewer design chart opposite the corresponding quantities of sewer flow. The sanitary portion of the chart was designed strictly on a population basis, with a sufficient safety factor to lead to an over-design. The chart is designed for the minimum size storm sewers considered economically safe in the City of Erie and a different runoff coefficient may be necessary in the application of the method in other areas. A design chart (based on Kutter's formula n = 0.013) is presented and the use of this method is illustrated and the procedures followed in applying the method are described. The chart is based on an average condition in Erie but its use in another area would possibly require an entirely different set of figures due to local design considerations. It is pointed out that, while the calculations and intentions of the sewer design chart is to over-design, it is still necessary for the final design to be checked to determine if the area under consideration is similar to that for which the chart was developed and includes all the potential drainage basin. A chart showing a rainfall intensity curve used for storm sewer design in Erie is also presented. W69-02198

PROGRESS TO DATE AND CURRENT WORKS AT GLENROTHES NEW TOWN,
For primary bibliographic entry see Field 04A. For abstract, see . W69-02199

DRAIN THAT GREW AND GREW.

G. B. Wilkes, and J. R. Beilby Can Mun Utilities, Vol 103, No 4, pp 15-17, April

Descriptors: *Storm drains, Outlets, *Velocity, *Spillways. Identifiers: *Storm sewers.

Features of Wilson Heights-Spadina Expressway storm trunk drain, Toronto, Ont; length of line selected is approximately 13,000 ft, and difference in elevation between invert of sewer at interchange and Don River outfall is approximately 136 ft; grade of sewer was chosen at 0.45% to keep maximum velocities below erosion velocity; with this grade, sewer was constructed from 34 to 80 ft below ground level until it interrupted gully which ran back in from river; feasibility of carrying water in open channel via gully with small spillways to dissipate energy was ascertained. W69-02206

SOIL AND WATER PROBLEMS ON BUILDING SITES, D. A. Williams.

Pub Works, Jan 1961.

Descriptors: *Land use, *Construction, *Water pollution, Outlets, Recreation facilities, *Stilling

Identifiers: *Storm sewers.

Areas under construction such as new suburbs where all vegetation is stripped off and natural water courses are disturbed with streets, buildings, etc. are creating erosion problems with siltation of rivers and lakes. Even areas designed with storm sewers experience this problem because of the time lapse to get cover, lawn, etc. to grow. A study was made at a 8,200 acre undeveloped area outside Memphis, Tennessee, that is scheduled for development and the engineers recommended the constructing of 44 detention basins to be built at a cost of \$1,400,000 instead of storm sewers. Basins to be designed to retain 60% of a 6-hour rainfall of 100-yr occurrence. The outlets would empty the basins in 24 hours. The larger detention sites could become green acres for parks and recreational use. Smaller basins or dry basins could be landscaped in with development. W69-02207

GRAPHIC STORM SEWER DESIGN,

G. E. Zoellner.

Water and Sewage Works, Vol 109, p 447, Dec

Descriptors: *Design, Storm runoff, Overflow, *Rainfall intensity, Weirs.

Identifiers: Calculations, *Storm sewers, Storage

The exorbitant costs of storm sewer systems require the decision as to the degree of protection to be provided against property damage, nuisance, and inconvenience from surcharged sewers. The exact determination of the permissible frequency is not possible with the presently used methods, e.g., empirical formula and Rational Method. The Graphic Method, as used in Germany for 50 years, makes it possible to determine exactly the runoff for any frequency of surcharging, and this runoff is based on the most critical rainfall for each sewer stretch with regard to the relationship of rainfall intensity to rainfall duration. The Graphic Method permits analysis of storm water reservoirs and calculation of excess flows that are diverted over a weir as the rate of flow with respect to the time is given. The illustrated example shows that the storm sewer system designed with the Rational Method based on a 5-year storm frequency and 15 min. time of concentration will actually surcharge once a year. W69-02208

SOME PROBLEMS IN THE HYDRAULIC DESIGN OF SMALLER TREATMENT WORKS, For primary bibliographic entry see Field 05D. For abstract, see . W69-02228

NO STORM-WATER BYPASS,

For primary bibliographic entry see Field 05D. For abstract, see W69-02229

TURKEY CREEK SEWAGE PUMPING STA-

For primary bibliographic entry see Field 05D. For abstract, see . W69-02232

EMERGENCY ALUM TREATMENT OF OPEN RESERVOIRS

For primary bibliographic entry see Field 05D.

For abstract, see W69-02234

MAD RIVER, HUMBOLDT AND TRINITY COUNTIES, CALIFORNIA. Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 359, 330 p, 1968. I plate, 4 append, 1 attach.

Descriptors: *Multiple-purpose projects, *Flood control, *Recreation, *Water supply, *California,

Rockfill dams, Reservoirs. Identifiers: *Mad River, Butler Valley, Humboldt

County, Trinity County.

Flooding, recreational needs, and water-supply problems of Mad River, north of San Francisco, California, were surveyed and a multiple-purpose dam and reservoir project is recommended. By constructing a rockfill dam 350 ft high, 1,850 ft long, creating a reservoir of 460,000 acre-ft capacity in Butler Valley, practically all the flood damage (potentially \$438,000 per year) can be eliminated, water yield of 160,000 acre-ft per year could be developed, and an estimated 2 million visitors per year could use the reservoir for recreation. The initial cost is estimated to be \$35,100,000 and the benefit-cost ratio is 1.7 to 1. (Knapp-USGS) W69-02280

LOWER CHARLES RIVER WATERSHED, MASSACHUSETTS.

Corps of Engineers, Washington, D. C.

US 90th Congr, 2d Sess, House Doc No 370, 81 p, 1968. 2 plate, 2 map, 6 photo, 5 tab, 1 append, 1 at-

Descriptors: *Dams, *Flow control, *Outlet works, *Sluices, Impoundments, Cost-benefit ratio, Reservoirs, River regulation, Recreation.

Identifiers: Boston (Massachusetts), Charles River

The ability of the sluice gates of the Charles River Dam in Boston, Massachusetts, to pass increased runoff resulting from increased urbanization was investigated and found inadequate. The dam, which impounds 8.6 river miles, was constructed to prevent tidal flooding of lowlands, sewers, and drains and to create a recreational pool over previously unsightly tidal flats. Damages in August 1955 caused by inability of the sluice gates to pass a record flood amounted to \$5.5 million, and if repeated today would cost \$12.4 million. The dam cannot economically be modified. It is recommended that a new dam be built with a pumping station, 3 locks, a highway viaduct, and appurtenant structures. First cost is \$26,500,000, annual cost is \$184,000, and benefit-cost ratio is 1.9 to 1. (Knapp-USGS) W69-02281

Field 08-ENGINEERING WORKS

Group 8A—Structures

PAPILLION CREEK AND TRIBUTARIES, NEBRASKA.

Corps of Engineers, Washington, D. C.

US 90th Congr, 2d Sess, House Doc No 349, 174 p. 1968. 2 fig. 17 tab, 2 append, 1 attach.

Descriptors: *Multiple-purpose projects, *Flood control, *Recreation, *Water quality, *Dams, Nebraska

Identifiers: Omaha, Papillion Creek.

A multiple-purpose flood control, water quality control, and recreational project is proposed for Papillion Creek, Omaha, Nebraska. The project includes 21 dams and reservoirs, in 8 of which waterquality control provisions would be included. Estimated cost is \$26,800,000. Hydroelectric power and navigation development are infeasible. The benefit-cost ratio of the 21 reservoirs as proposed is 2.0 to 1. (Knapp-USGS) W69-02282

BEAR CREEK BASIN, SOUTH PLATTE RIVER AND TRIBUTARIES, COLORADO, WYOMING, AND NEBRASKA.

Corps of Engineers, Washington, D. C.

US 90th Congr, 2d Sess, Senate Doc No 87, 175 p, 1968. 1 map, 11 tab, 4 append, 1 attach.

Descriptors: *Flood control, *Recreation, *Dams, Multiple-purpose projects, Colorado. Identifiers: Denver, Morrison, Bear Creek

To control flooding of Bear Creek, a left-bank tributary of the South Platte River in metropolitan Denver, Colorado, a multiple-purpose flood control and recreational reservoir is proposed. The recreational pool would have an area of 130 acres. The estimated cost is \$20,851,000. Estimated annual flood damage potential is \$1,103,000. Estimated annual flood protection benefit is \$930,000. (Knapp-USGS) W69-02283

COLORADO RIVER AND TRIBUTARIES, TEX-AS, COVERING MOUTH OF COLORADO

Corps. of Engineers, Washington, D. C.

US 90th Congr, 2d Sess, Senate Doc No 102, 85 p, 1968. I plate, 6 tab, 1 append.

Descriptors: **Multiple-purpose projects, *Flood control, *Navigation, *Channels, Canals, Jetties, Diversion, Bank stabilization, Levees, Texas. Identifiers: Turning basins, Colorado River (Tex-

A multiple purpose project is recommended to improve navigation and flood control at the mouth of the Colorado River, Texas. It was found that the best plan would provide for diversion of the Colorado River into Matagorda Bay and conversion of the existing river channel into a navigational channel with jetties at the Gulf shore line and a turning basin at the town of Matagorda. Specific measures are provided to satisfy needs for a navigable channel from Matagorda, Texas, to the Gulf of Mexico, and to develop the recreation potential of the area. The improvements will also realize benefits from reduction of flood damages to existing developments along the Colorado River chan-nel below the point of diversion and from increase in commercial seafood catch. The estimated first cost to the United States for all recommended new work is \$11,554,000, of which \$128,000 would be reimbursed by local interests. The estimated increase in annual maintenance cost for the project is \$166,000, including \$24,000 non-Federal annual maintenance cost. The annual charges of the recommended project are estimated at \$660,000 and the annual benefits are estimated at \$837,000. The ratio of annual benefits to cost is 1.3 W69-02292

WILD RICE RIVER, MINNESOTA. Corps. of Engineers, Washington, D. C.

U S 90th Convr, 2d Sess, House Doc No 366, 229 p, 1968. 3 plate, 16 tab, 1 attach, 2 append.

Descriptors: *Multiple-purpose projects, *Flood control, *Recreation, *Dams, Minnesota. Identifiers: Wild Rice River, Marsh River.

A multiple-purpose project is proposed to alleviate recurrent flooding which causes serious damage to agricultural land along the Wild Rice and Marsh Rivers, Minnesota, and to increase recreational facilities in the area. The 1965 flood damages totalled \$840,000. Recreational needs are urgent. A reservoir is recommended on the Wild Rice River above Twin Valley, Minn., at an estimated cost of \$8,155,000. The benefit-cost ratio is estimated to be 1.5 to 1. (Knapp-USGS) W69-02297

PECAN BAYOU, TEXAS.

Corps. of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 350, 326 p. 1968. 5 fig. 2 plate, 6 tab, 4 append, 1 attach.

Descriptors: *Multiple-purpose projects, *Water supply, *Flood control, *Recreation, *Dams, Texas, Channel improvement.

Identifiers: Pecan Bayou, Brownwood, Coleman.

Study of the dam and spillway at Lake Brownwood, Texas, shows that the structures are in urgent need of repair and replacement to prevent dam failure and catastrophic flooding of the city of Brownwood. In addition, present flood and watersupply problems exist. It is recommended that the present Lake Brownwood dam and spillway be reconstructed, channel improvements be made along Pecan Bayou, Adams Branch, and Willis Creek in Brownwood, and that Pecan Bayou and Coleman reservoirs be constructed upstream from Lake Brownwood. The previously authorized enlargement of Lake Brownwood is considered uneconomic and it is recommended that it be deauthorized. The estimated improvement cost is \$33,691,000. (Knapp-USGS) W69-02298

8C. Hydraulic Machinery

ONE WAY TO BYPASS A LARGE SEWER. Charles A. Manganaro.

Water Works and Wastes Eng, Vol 1, pp 46-47, July 1964.

Descriptors: *Automatic control, Instrumentation, *Overflow, Design. Identifiers: *Sewer infiltration.

A unique plug valve designed to permit automatic bypass of an 84 in. trunk sewer has been installed by the Bergen County Sewer Authority in New Jersey. An overflow chamber was constructed over the 84 in. line just before the sewer crosses the Hackensack River. The valve consists of a large circular plate with a continuous circular neoprene gasket riveted to the underside to prevent infiltration of water due to tidal conditions and also to seal against odors when not operating. The cylinder, mounted on the underside of the plate, acts as a buoyant force and the lift is counteracted by the addition of lead ballast into the cylinder. The valve is designed to lift when the gradient of the sewer is 2 in. above the top of the overflow chamber. Side guides set around the cylinder keep the valve centered. Valve stops are mounted above the overflow chamber to prevent the valve from being lifted out of the opening. The complete valve, weighing about 4,000 lb, can be lifted for inspection by means of jacks. W69-02105

MAINTENANCE OF STORM FLOW REGULA-TORS.

Max B. Phillips.

Sewage and Industrial Wastes, Vol 31, No 7, p 861, July 1959.

Descriptors: *Storm runoff, *Instrumentation, *Flow control, Maintenance.

A survey was made of cities in the State of Ohio as to the use and performance of regulators. Thirty per cent of the cities reported that regulators were a major problem and a break-down of the kinds of malfunctioning is given. An outline of a workable program of regulator inspection and maintenance W69-02108

WASTE TREATMENT PLANT MODIFIED FOR INCREASED SOLIDS LOADING,

For primary bibliographic entry see Field 05D. For abstract, see. W69-02110

PROGRESS REPORT-ASCE COMBINED SEWER SEPARATION PROJECT,

For primary bibliographic entry see Field 08A. For abstract, see . W69-02141

ASCE COMBINED SEWER SEPARATION PRO-JECT PROGRESS.

For primary bibliographic entry see Field 08A. For abstract, see. W69-02142

THE TRUNK SEWER SYSTEM AND THE SEWAGE-TREATMENT PLANT OF THE TOWN OF UTRECHT. II. STORAGE CAPACI-TY OF SEWERS AND PUMP REGIME, For primary bibliographic entry see Field 05D

For abstract, see . W69-02162

OIL RETENTION IN STORM-SEWAGE PUMP-ING STATIONS AND STORM-SEWAGE STORM-SEWAGE

For primary bibliographic entry see Field 05D. For abstract, see . W69-02181

ARE PROTECTED STORM WATER OUTLETS DANGEROUS TO STREAMS.

For primary bibliographic entry see Field 05B. For abstract, see. W69-02189

8D. Soil Mechanics

EFFECT OF USING CONTINUALLY SUB-MERGED DRAINS ON DRAIN SPACINGS. For primary bibliographic entry see Field 04A. For abstract, see. W69-02205

AN INVESTIGATION INTO INFILTRATION AND INTERCEPTION RATES DURING STORM RAINFALLS AND THEIR APPLICATION TO FLOOD PREDICTION,

Allan O. Lambert.

J Instn of Water Engrs, Vol 21, No 6, pp 525-35, Aug 1967.

Descriptors: *Rainfall-runoff relationships, *Hydrographs, *Runoff forecasting, Flood

An investigation was made into the relationship between combined infiltration and interception rates during periods of heavy rainfall and factors representing various soil-moisture conditions. The

hydrometric data were obtained from a catchment area of 18.5 sq miles in South Lancashire. A flood analysis method capable of predicting direct runoff in hourly intervals was developed. This method, combined with the use of unit hydrographs, provided accurate predictions of both the magnitude and temporal distribution of the river hydrographs. W69-02242

8G. Materials

LOW PRESSURE AIR TEST FOR SANITARY SEWERS.

For primary bibliographic entry see Field 08A. For abstract, see . W69-02167

EXPERIENCE IN USING LOW-PRESSURE AIR TEST FOR SANITARY SEWERS,

For primary bibliographic entry see Field 08A. For abstract, see . W69-02168

LOW PRESSURE AIR TEST FOR SANITARY SEWERS,

For primary bibliographic entry see Field 08A. For abstract, see . W69-02169

REHABILITATION OF SANITARY SEWER

For primary bibliographic entry see Field 08A. For abstract, see . W69-02171

INFILTRATION IN SANITARY SEWERS,

For primary bibliographic entry see Field 08A. For abstract, see. W69-02174

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

THE USE AND INTERPRETATION OF HYDROLOGIC DATA.

United Nations Economic Commission for Asia and the Far East.

ECAFE Water Resources Ser No 34, 195 p, 1968. 158 fig, 90 tab.

Descriptors: *Training, *Professional personnel, *Hydrology, *Statistics, *Data processing, Forecasting, Infiltration, Runoff, Precipitation (Atmospheric), Streamflow, Water yield, Evapotranspiration, Groundwater.

Identifiers: ECAFE (United Nations), Training

A training seminar in hydrology conducted by the United Nations contains lectures on methods of collecting hydrological data, basic statistics, predictive methods, application of statistical methods to hydrologic data reduction, and selected examples of analytical techniques. The countries for which the lecture series was given listed assessment of mean stream yield and minimum flows, estimation of flood magnitude, assessment of evaporation and evapotranspiration, infiltration, and estimation of safe groundwater yields as their major training needs. These needs require training in statistics as well as in the elements of hydrology. The experience of the consultants is valuable in training new hydrologists, and an attempt was made to include as many results of their field experience as possible. (Knapp-USGS) W69-02334

9D. Grants, Contracts, AND Research Act **Allotments**

COMBINED SEWER STUDY. Herbert G. Poertner. APWA Reporter, p 6, June 1967.

Descriptors: *Surveys. Identifiers: *Combined sewers.

A brief announcement of an FWPC contract to the APWA Research Foundation concerned with combined sewers is presented. On-site personal interviews will provide detailed information on the combined sewer systems of approximately 900 communities. Officials of all cities of over 25,000 population plus a maximum of 30% of those in smaller communities will be interviewed.

STATUS OF WATER RESEARCH IN THE UNITED STATES.

Department of Interior, Washington, D. C. Office of Water Resources Research. Roland R. Renne.

Journal of the American Water Works, Vol. 60, No. 7, July 1968, p 749-54.

Descriptors: Water pollution, Water supply, Water demand, *Research and development, Water treatment, Financing, Expenditures, State governments, Local governmets, *Water Resources Planning Act, *Water Resources Research Act. Identifiers: Budget, *Water research goals, Basic research, Water Quality Act of 1965.

There are six major types of water problems: pollution, inadequate supply, uneven distribution, floods, variability of supply and demand, and water treatment. The main problem is not a shortage of water, but a shortage of ideas, technology, and management abilities to utilize the available supplies more effectively. To solve this problem, new research, well funded and organized, must be undertaken. New legislation by Congress, the Water Resource Research Act of 1964, the Water Resource Planning Act of 1965, the Water Quality Act of 1965, and the Clean Water Restoration Act of 1966, has contributed to advancements in research planning and development. Seven goals are outlined which should direct the basic research undertaken. Present expenditures in federal research efforts are reviewed and 'short fall areas' where investment in research has not been sufficient are discussed. Eight possible approaches to the solution of the water problem: (1) purification or treatment of wastes to make the water usable; (2) reuse treatment after each major use; (3) restricted or curtailed use through metering or higher charges; (4) use classifications for water quality; (5) improved management of watersheds to increase water recharge; (6) desalting; (7) weather modification; and (8) importation from other areas. (Gargola-Chicago) W69-02400



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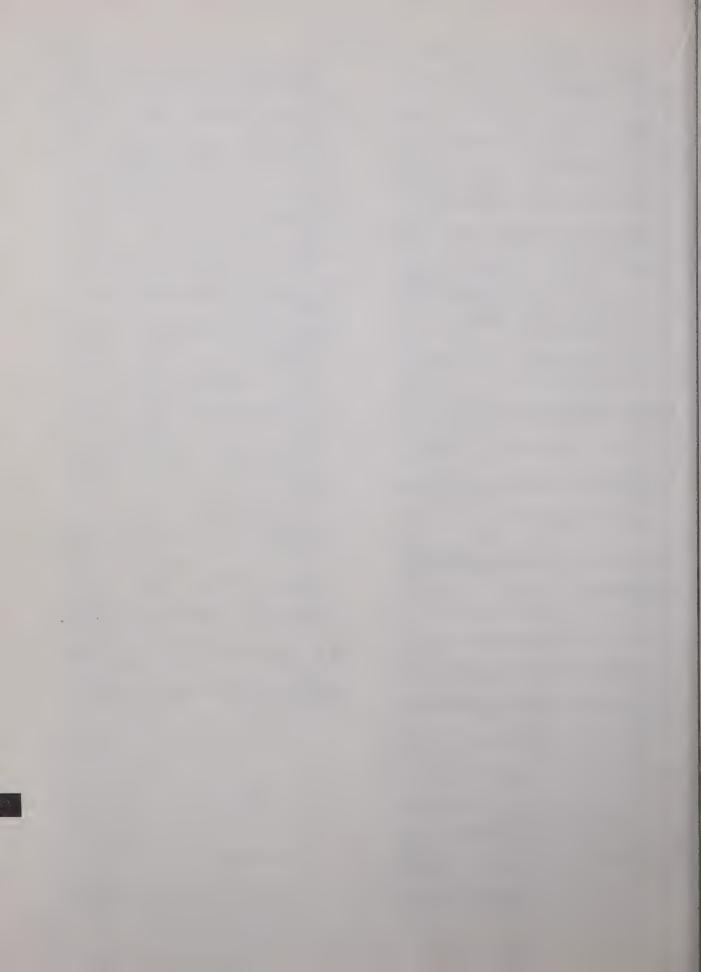
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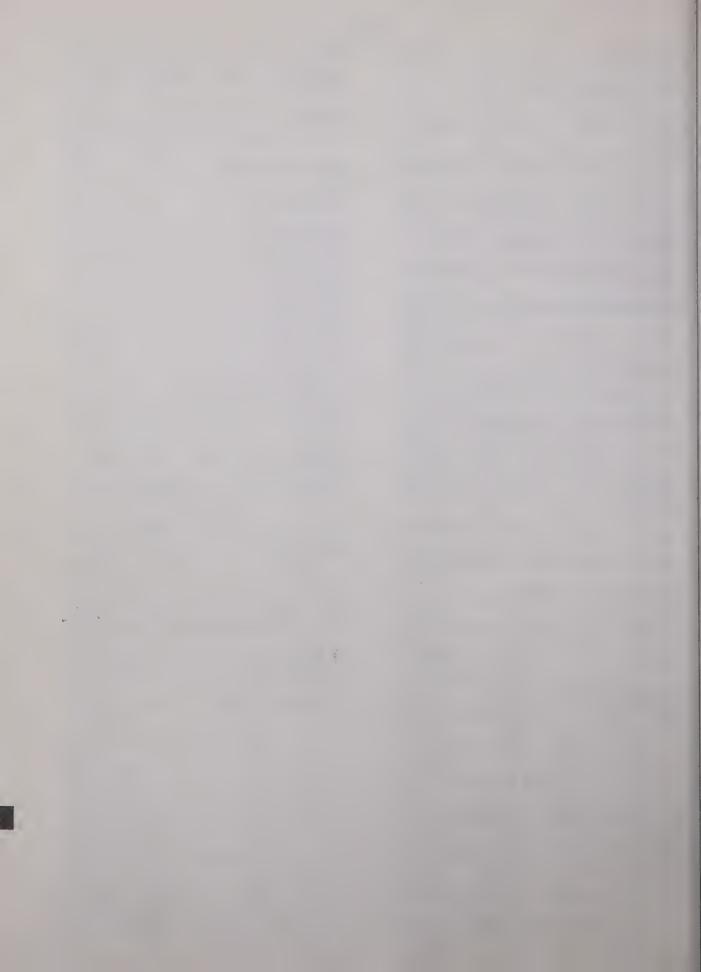
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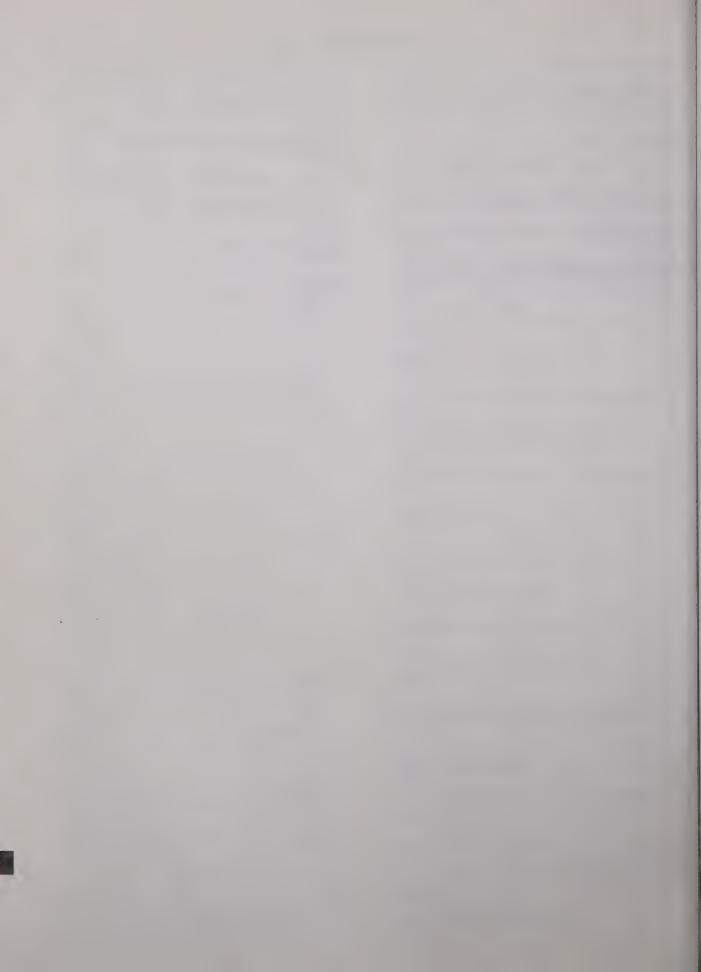
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